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A MANUAL

OF

PHARMACOLOGY

AND

THERAPEUTICS.

BY

WILLIAM MURRELL, M.D., F.R.C.P.,

PHYSICIAN TO AND LECTURER ON PHARMACOLOGY AND THERAPEUTICS AT THE WESTMINSTER HOSPITAL;
LATE EXAMINER IN MATERIA MEDICA IN THE UNIVERSITY OF EDINBURGH,
AND EXAMINER IN MATERIA MEDICA AND PHARMACY TO THE CONJOINT BOARD OF THE ROYAL COLLEGE OF SURGEONS OF ENGLAND, AND THE ROYAL COLLEGE OF PHYSICIANS OF LONDON.

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PREFACE.

PHARMACOLOGY has of late attained such importance in the Medical Curriculum, that a Student's Text Book on the subject is urgently needed. This work is an abstract of the Lectures delivered at the Westminster Hospital during the current session. It is adapted primarily to the requirements of students preparing for the examinations of the Conjoint Board of the Royal College of Surgeons of England, and the Royal College of Physicians of London.

The Therapeutical aspect of the question has been treated practically, and it is hoped that the large number of prescriptions scattered throughout the pages of the book will prove of use to practitioners who desire to keep abreast with the progress of modern treatment.

WILLIAM MURRELL.

17, WELBECK STREET,
CAVENDISH SQUARE, W.

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PHARMACOLOGY AND THERAPEUTICS.

DEFINITIONS.

Materia Medica, strictly speaking, implies a description of the properties and uses of the material substances employed in the treatment of disease; but, in a more extended sense, it includes all remedial agents of whatever kind.

Pharmacology is the science of the action of remedies, and deals with the modifications produced in healthy conditions by the operation of substances capable of producing modifications. It means the same as the expression, "the physiological action of drugs." The term was introduced into this country by Fraser of Edinburgh, who says, "The methods of investigation which it requires are totally distinct from those followed in the study of either pharmacy or pharmacognosy, and so it is that the specialist in this subject may have but little knowledge of pharmacy or pharmacognosy, and may never concern himself with the investigation of their problems." It constitutes the chief basis for the application of remedies in disease, it is closely allied to therapeutics, and may be regarded as the connecting link between Materia Medica and the art of Medicine.

Pharmacognosy implies the recognition of drugs by their physical and chemical characters, and the detection of adulterations.

Pharmacy deals with the processes for making the various pharmaceutical preparations of drugs.

Dispensing is the "putting up" of medicines in a form suitable for administration.

Therapeutics is that branch of Medicine which has for its object the treatment of disease.

The distinction between pharmacology and therapeutics is perfectly clear. If we have a patient suffering from phthisis, and give him a hundredth of a grain of atropine with the view of checking his night-sweating, that is an example of a therapeutical action. If, on the other hand, we take a frog, and, after pithing it, open the thorax and pericardium, and apply a drop of a solution of atropine to the heart and see what it will do, that investigation falls within the range of pharmacology.

The distinction between pharmacy and dispensing is also clear. The pharmacist is practically the wholesale manufacturer, whilst the dispenser is the distributor of medicines. The dispenser is, as a rule, a skilled pharmacist, but there are a good many useful dispensers, in hospitals and elsewhere, who are not capable of making pharmaceutical preparations, and have very little knowledge of either pharmacy or Materia Medica. A pharmacist must be a good chemist and a good botanist; but the dispenser may fulfil a very useful function without troubling his head very much about such trivialities.

THE SCOPE OF MATERIA MEDICA AND THERAPEUTICS.

Most modern works on Materia Medica deal only with drugs and their effects, but this is simply a matter of convenience. If we take any of the older books on Materia Medica, we find a great many things treated of that are now

relegated to special treatises. Thus in the fourth edition of Pareira, published in 1854, we find, in addition to the ordinary chapters on drugs, articles on such subjects as "Hope as a Therapeutic Agent," on "Monotony as a Means of Inducing Sleep," on "Light and Darkness," on "Hot and Cold Baths," on "Electricity, Magnetism, Mesmerism," and so on. Authors are not even agreed as to the proper limits of therapeutics. In its broadest sense it embraces all known means of cure, even surgical operations; but by general consent we relegate to a distinct branch—that of surgery—the consideration of such questions as ligatures, amputations, excisions, etc., reserving to ourselves, however, the right to treat of such subjects as hypodermic injections, acupuncture, etc. It also comes within our province to discuss the treatment of disease by baths, packing, massage, and other similar means. We also deal with certain so-called systems of cure, such as the movement cure, the koumiss cure, the skim-milk treatment, the whey cure, the grape cure, and many others which need not be referred to in detail.

OLD-FASHIONED REMEDIES.

In former times many curious remedies were used in the treatment of disease. Thus the magi or priests of the Persians, the wise men of the East, knew of herbs which, wrought into pills and swallowed in wine, would make the guilty confess their secrets. They had also a herb for begetting good and handsome children, and a wort to revive old love even when it had turned to hate. All these had magic names. They thought highly of the common mole, and taught that if any one swallowed its heart palpitating and fresh, he would become an expert in divination. The heart of a hen, they said, placed upon a woman's left breast

whilst she slept, would make her tell her secrets, if only her memory served her. The magi also taught to drink the ashes of a pig's pizzle in sweet wine, and so to make water into a dog's kennel, adding the words, "lest he like a hound should make urine in his own bed." If a man in the morning, they said, made water a little on his own foot, it would be a preservative against *mala medicamenta*, or drugs intended to do him harm.

Pliny mentions many curious remedies. Thus, speaking of ague, he tells us how to cure it by amulets, by the dust in which a hawk has rolled, by the longest tooth of a black dog, by a solitary wasp caught in the left hand, by the head of a viper cut off and its living heart cut out and wrapped in a piece of cloth, by the snout and tips of the ears of a mouse, and so on.

Marcellus recommends, in order to avoid inflamed eyes, that when you see a star fall or cross the heavens, you should count quickly, for you will be free from inflammation for as many years as you count numbers. If a man, he says, have a white spot or cataract in his eye, let him catch a fox alive, cut his tongue out, let him go, dry his tongue and tie it up in a red rag, finally hanging it round the neck. For toothache, you are requested to spit in a frog's mouth and tell him to make off with it.

Ettmüller is conspicuous for recommending disagreeable and even revolting remedies. A prominent feature of his treatment is the employment of the excrement of various animals. Album canis or album græcum, in other words the white of dogs, is recommended for bleeding, and also as a gargle for sore throat.

In connection with the introduction, during the last few years, of testicular products and other extracts of animal origin as remedial agents, it is interesting to note that during the seventeenth century we find reproductive

products, as obtained from mammals, birds, and fishes, enjoying a high reputation in the treatment of nervous derangements. They were generally employed to increase virility and restore sexual vigour, many of them finding a prominent place in the "London Pharmacopœia" of 1676.

What drugs were first employed as medicinal agents it is difficult to say, but it is probable that the earliest inhabitants of the globe resorted to the use of water both for external and internal application, and were in this sense hydropaths. Charcoal, in the form of wood-ashes, naturally soon attracted attention, and its medicinal virtues must have been familiar to man from the most remote period of antiquity.

Sulphur or brimstone, which occurs so largely in volcanic regions, was known in the time of Moses, and is mentioned in Genesis and also in the "Iliad."

The linseed or flax was cultivated in the earliest times, and was well known to Pliny.

Many drugs now in daily use are mentioned by name or described in the Bible. For example, the "wild vine" referred to in the Old Testament is supposed to be the plant known to us as colocynth. Its active purgative properties would fully justify the exclamation of the partakers of the pottage, "There is death in the pot!"

The spotted hemlock or conium maculatum was the state poison of ancient Athens, and is generally supposed to have been the instrument of Socrates' death. Foxglove was not generally used in medicine until about the time of the Norman conquest. The broom was used in ancient Anglo-Saxon medicine, and under the name of planta genista has not failed to leave its mark on English history. Many of our most valued medicines—morphine, quinine, chloroform, ether, cocaine, pelocarpine, gelsemine, and a host of others—are products of the *present* century. Almost

every day we witness the introduction of new remedies, some to supersede old-fashioned drugs, others to be used for a time and then cast aside in favour of some more fortunate rival.

THE SOURCES OF DRUGS.

Medicines are obtained from many and varied sources, all three kingdoms of nature being laid under contribution.

Some, such as sulphur and magnesia and the different salts of iron and mercury, are procured either directly or indirectly from the mineral kingdom; others, such as aconite, belladonna, and opium, come from the vegetable kingdom; whilst a few, such as cantharides, cod-liver oil, and pepsin, are furnished by animals.

A good many drugs, such as nitrite of amyl, nitro-glycerine, and chloral, are organic compounds artificially prepared, and are not merely extracted from vegetable substances containing them. This source is daily increasing in importance, and it is not improbable that in course of time drugs prepared in this way will, to a very great extent, supersede the vegetable Materia Medica.

Medicines are imported from all quarters of the globe, almost every country, civilized or uncivilized, furnishing some useful contribution to the healing art. Senna is obtained from India, opium from Asia Minor, Egypt, and Persia, jaborandi from Pernambuco, jalap from Jalapa in Mexico, quassia from Jamaica, cinchona from the cloudy slopes of the Andes, and ipecacuanha from the Brazils, whilst the animal which yields musk is a native of the mountainous regions of Central Asia.

Fortunately, some of our most valued and popular remedies are furnished by plants which grow at our very doors. Thus the well-known garden plant, which is called in this

country monkshood or wolfsbane, and in Ireland blue rocket, yields us aconite; salicin is extracted from the common willow; digitalis is obtained from the foxglove, whose long stately racemes of purple-coloured flowers are the pride of many a cottager's garden. The leaves of the thorn-apple, or stramonium, when smoked in a pipe or in the form of a cigarette, have relieved the attacks of shortness of breath of many a chronic asthmatic; whilst the meadow-saffron, or colchicum, has proved a boon to many a gouty old gentleman.

LIST OF INDIGENOUS MEDICINAL PLANTS.

Monkshood	*Aconitum napellus.*
Deadly nightshade	*Atropa belladonna.*
Foxglove	*Digitalis purpurea.*
Henbane	*Hyoscyamus niger.*
Hemlock	*Conium maculatum.*
Thorn-apple	*Datura stramonium.*
Autumn crocus	*Colchicum autumnale.*
White mustard	*Sinapis alba.*
Black mustard	*Sinapis nigra.*
Linseed	*Linum usitatissimum.*
Red poppy	*Papaver rhœas.*

SERUM THERAPEUTICS.

Of late there has been an enormous development in the use of animal products as therapeutical agents.

This new departure was to a great extent the result of Brown-Sequard's observations with orchitic fluid. His account may not have been strictly accurate, and his statements were undoubtedly considerably exaggerated; but, for all that, the credit is due to him of having drawn prominent attention to a subject of considerable interest and importance.

Organic sterilized fluids have been largely employed, chiefly in the form of injections, in the treatment of many diseases. Orchitic or testicular fluid has been recommended in senile mental debility and in the treatment of locomotor ataxy. Cerebrin, the fluid extracted from the grey matter of the brain, is said to be useful as a nerve tonic and in neuræsthenia. A renal extract has been suggested as a cure for Bright's disease; whilst the fluid of the pancreas has been employed in diabetes. Preparations of the thyroid have been used with much success in myxœdema, obesity, and psoriasis; whilst the supra-renal fluid has been given in Addison's disease. An extract of the medulla of bone has been found useful in persistent anæmia and leucocythæmia; whilst muscular fluid has been recommended in muscular atrophy. Many of these are merely in the stage of suggestion, and their value is unsupported by good clinical evidence. Another animal product, the tuberculin of Koch, although it has failed to answer the expectations formed of it as a curative agent, is useful for diagnostic purposes. The discovery of this substance, even if it has not cured patients suffering from phthisis, has placed in the hands of veterinary surgeons a weapon by means of which stock may be freed from tuberculosis at a cost absurdly small compared with the steady loss entailed by the present neglect of every reasonable precaution against the inevitable spread of the disease.

The greatest advance in the use of animal products in the treatment of disease was the introduction of antitoxin. The results of the injection into patients suffering from diphtheria of the blood-serum of animals artificially immunized against the disease achieved by Behring and his colleagues in the hospitals of Berlin and other places in Germany, and by Roux and Martin in Paris, were brought prominently before the International Congress of Hygiene at Buda-Pesth in

September, 1894. The fact that a variety of toxins, such as the diphtheria and tetanus toxins, abrin, ricin, and snake-venom, when administered to animals in repeated non-fatal but gradually increasing doses, imparts to them a high degree of resistance, and that the blood of such animals acquires specific antitoxin powers so that its serum can be used as a therapeutic agent, is now well established. From a scientific point of view, the value of antitoxic serum rests on a firm basis, and the clinical evidence in its favour, obtained from all quarters of the globe, is overwhelming. Since the introduction of the dried antidiphtheric serum this mode of treatment has advanced steadily in professional favour. The antitoxin of tetanus and the antitoxin of glanders have been equally well received, and there is reason to hope that before long all diseases of bacillary origin will be treated by antitoxins. The researches of Professor Fraser of Edinburgh have placed us in possession of antivenene, a substance derived from animals protected against serpent-venom, and have practically solved the difficulties so long experienced in finding a reliable remedy for snake-bite. Serum therapeutics now holds an established position, and we may reasonably anticipate still greater developments in this direction.

The recent researches of Schäfer and Oliver have thrown considerable light on the mode of action of one or two important animal products. They find that extract of thyroid gland produces a distinct action on the blood-vessels, so that the blood-pressure falls to a very notable extent, although the beats of the heart remain at about the same rate and of the same strength. This effect is evidently due to an increase of the calibre of the blood-vessels. The extract obtained from the supra-renal bodies has an entirely different action. The medulla of the supra-renal capsule contains a dialyzable organic principle soluble in water, and

not destroyed by boiling for a short time. It has a powerful physiological action on the muscular system in general, especially on the skeletal muscles, the muscular walls of the blood-vessels, and the muscular wall of the heart. Some action is also manifested on some of the nerve-centres in the bulb, especially the cardio-inhibitory centre, and to a small extent on the respiratory centre. The effect on the skeletal muscles is to greatly prolong the contraction resulting from a single excitation of its nerve, an action comparable with that produced by veratria. The action on the heart and on the arterial system is well marked. When the vagi are uncut, and the heart is therefore still in connection with the cardio-inhibitory centre in the medulla oblongata, the action of the supra-renal extract is to slow and even to arrest the contraction of the auricle. The ventricle continues to beat with an independent slow rhythm, so that the pulse is very slow. When the vagi are cut, or their cardiac ends are paralyzed by atropine, the strength and frequency of the auricular contractions are markedly increased, whilst those of the ventricle are correspondingly augmented. The direct action of the drug on the arteries is even more marked than on the heart. A few minutes after the injection of the drug, even with the vagi uncut, the blood-pressure rises considerably. When a limb or the kidney or spleen is enclosed in a plethysmograph or oncometer, the instrument indicates an enormous diminution in the volume of the organ, clearly due to contraction of its arterioles. This contraction has been proved to be the result of the direct action of the drug upon the muscular wall of the smaller arteries, and is not due to an indirect [illegible] through the vaso-motor centre. A still more curious [illegible] in connection with this new drug is the small-[illegible] As little as five and a half milligrammes [illegible] will produce a maximal effect upon the

heart and arteries in a ten-kilogramme dog, equivalent to about half a milligramme per dog-pound. From this we arrive at the conclusion that the active principle of the supra-renal capsules, taken in the proportion of not more than a millionth part of a gramme per killigramme of body weight, equivalent to less than $\frac{1}{800}$ grain for an adult man, is capable of producing a well-marked physiological effect. This, in the matter of small doses, comes very near breaking the record. Nitro-glycerine will produce its effects in doses of $\frac{1}{200}$ grain, and possibly, in some susceptible people, in even smaller quantities. The smallest fatal dose of prussic acid recorded is thirty minims of the British Pharmacopœia solution, equal to $\frac{6}{10}$ of a grain of the anhydrous acid.

ADULTERATION OF DRUGS.

This is an interesting subject. Some people object to the term "adulteration," and prefer calling it "sophistication;" but it amounts very much to the same thing, especially if you have paid for the pure drug. Adulteration, or sophistication, is the intentional addition to any article, for the purpose of gain or deception, of any substance the presence of which is not indicated by the name under which it is sold.

Deterioration is, of course, not the same as adulteration, but it belongs to the same family. It means those natural changes for the worse which take place in drugs as the result of age or exposure. Very many vegetable and other organic, as well as inorganic, combinations are susceptible to change under the influence of the atmosphere. It is well known that under such conditions a variety of deleterious products of chlorine are generated in chloroform. It has even been asserted that the emetic action which sometimes follows the hypodermic injection of morphine is due to the

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partial conversion of the alkaloid into apomorphine. Extract of hyoscyamus made from the dried leaves contains very little alkaloid, whilst an extract made from the fresh leaves yields a considerable percentage. The well-known variability of different specimens of ergot probably arises from the fact that ergot, unless carefully dried and packed in closely sealed receptacles, soon loses its activity. Freshly gathered pomegranate root bark is a reliable anthelmintic, but when dry and old it acts as an emetic and intestinal irritant.

"Substitution" is the sale of one article in place of and under the name of another. As a rule, collectors of crude vegetable drugs are but imperfectly acquainted with their botanical characters, and fail to distinguish accurately between allied species. It is asserted, on the authority of experts, that vegetable drugs in themselves of indifferent activity are from time to time found adulterated with belladonna leaves or hyoscyamus, in order to make them pass muster. Such additions, especially when in minute quantities, may easily escape detection, unless the examination is made with care.

In many cases the physical or chemical distinction between good and bad drugs is difficult, and sometimes impossible of determination. The activity of a drug often depends on its habitat. The respective commercial values of different varieties of opium, aloes, and colocynth, for example, depends very much on the country in which they are grown. Whilst one or two grains of Socotrine aloes will induce a comfortable evacuation of the bowels, a similar effect cannot be produced with any certainty from five times this dose of Arabian or Moka aloes. Digitalis grown on the hills is much more active than the foxglove which grows in valleys or is cultivated. Our English hemp is quite different in physiological action from the hemp grown in tropical climates, which yields haschish.

The season of the year at which a plant is gathered notably affects its medicinal activity. For example, digitalis, especially the mountain digitalis, gathered on the mountain ranges of Central Germany, is much more active when the plant is in full bloom and at the acme of its vigour. The corm and seeds of colchicum yield a much larger percentage of colchicum when the plant is in full bloom than at other periods of the year. The juice of *Ecballium elaterium*, or squirting cucumber, yields from four to five per cent. of elaterin when collected in July, whilst in September it is almost entirely destitute of this principle.

No difficulty is experienced in getting drugs of good quality if only the purchaser is prepared to pay a reasonable price for them. If you go to a "cutting chemist," you naturally expect to get a drug of poor quality. It cannot be too generally known that any drug can be obtained at almost any price—in name, at all events. The vendor simply adds so much inert material as will enable him to obtain the same profit as if he sold the genuine article. The chemist is not to blame; it is the system, often adopted in hospitals and dispensaries, of accepting the lowest tender for drugs, which is at fault.

Powdered drugs are commonly of inferior quality, for two reasons: first, because inferior and less sightly portions of the plant are employed in their preparation; and, secondly, because the facilities for adulteration are great. It is often found that powders are offered at the price of or at an inadequate advance upon the cost of the crude drug, notwithstanding the loss which of necessity results from powdering and drying.

Many pharmaceutical preparations, as ordinarily purchased, are not in accordance with the requirements of the Pharmacopœia. Tinctures vary materially in character

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and quality, and there is reasson to believe that many tinctures are systematically prepared of light weight, both as regards drug and menstruum, in order that they may be sold at a lower price.

Some years ago C. Lewis Diehl issued a report on "Deteriorations, Adulterations, and Substitutions of Drugs," in which he gave a list of roots which had at different times been examined by competent authorities. It was found that much of the aconite root sold was tasteless, and had evidently been first exhausted and then re-dried. Of three packages of arnica, one contained fifty per cent. of the true root, another only ten per cent., whilst the third contained none at all. Sarsaparilla was found to be adulterated with nut-galls, ipecacuanha, matico stems, paper, bark, straw, and bay-leaves. The common adulterants of ground pepper are pepper leaves, sage, rape-seed, potato, spices, capsicum, chicory, rye, bone-dust, and dirt.

All the highly priced drugs are special objects of adulteration. Quinine was at one time systematically sophisticated. In one instance finely picked cotton was added in order to increase the bulk; in another the specimen consisted almost entirely of salicin; whilst a large consignment of "sulphate of quinine" sent out to India contained not a trace of any of the cinchona alkaloids.

Even when drugs are not actually adulterated, they not uncommonly vary enormously in strength and activity. We have a good example of this in the case of pepsin. The test for pepsin given in the British Pharmacopœia is that two grains in an ounce of distilled water, to which five minims of hydrochloric acid have been added, form a mixture in which at least a hundred grains of hard-boiled white of egg passed through wire gauze of thirty-six meshes per linear inch, and made of No. 32 brass or copper wire, will dissolve on their being well mixed, digested, and

well stirred together for thirty minutes at a temperature of 130° Fahr. (54·4° C.). The standard adopted by most authorities both on the Continent and in America is the quantity of white of egg which one grain will dissolve at the temperature of the body in four hours. Some time ago I had occasion to examine a number of specimens of pepsin, and as the selection included nearly all the recognized brands the results are not without interest.

It may be as well to state, in the first place, that the specimens were not selected in any way. They were not picked samples obtained from the manufacturers for examination, but were *bonâ fide* specimens bought at an ordinary chemist's shop, care being taken to see that the original wrapper was unbroken, and that they presented no indication of having undergone deterioration by age or exposure to variations in temperature.

The estimation of the comparative value of different preparations of pepsin, although simple in theory, is by no means easy in practice, especially if accuracy is desired. The essential action of pepsin is proteolytic—the conversion of proteids into peptones—and this is usually taken as the test of the value of the specimen. The first point to decide is whether to use fibrin or egg-albumin. Following the example of Dowdeswell and other authorities, and being not unmindful of the requirements of the Pharmacopœia, I employed white of egg. The eggs must be quite fresh, and should be boiled in a uniform manner. The best way is to boil the water first, then put the eggs in all together and let them boil for ten minutes. If a shorter time be allowed, it will be seen that the white will not separate from the yolk nicely and cleanly. It will be found that on an average fifteen eggs yield 7000 grains of coagulated albumin, or perhaps a little less. Much depends on the state of subdivision of the white of egg. An attempt to

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obtain uniformity was made by pounding up together the whole mass after the removal of the membrane and yolk, and then rubbing it through a No. 30 sieve. This seemed to answer well, for when suspended in water and examined, the particles were found to be uniform both in shape and size. The next question was the strength of the acid, and here again, following Dowdeswell, it was determined to use distilled water acidulated with 1 per cent. hydrochloric acid of sp. gr. 1·150. The specific gravity of the acid was ascertained in the ordinary way by a Westphal's balance, the observation being made at 15° C. The necessity for having beakers of the same size and shape was fully recognized, and the mixture was constantly stirred. The observations were made at a temperature of 38° C. (100·4° Fahr.), that being approximately the temperature of the body. The beakers were maintained at a uniform temperature by placing them in a water-bath with a little jet of gas beneath. It was not thought necessary to use a gas regulator, as the thermometer was carefully and constantly watched, and never varied more than a degree, or at the most a degree and a half. The test proposed was the quantity of coagulated white of egg digested by one grain of pepsin in four hours in eight ounces of 1 per cent. hydrochloric acid at a temperature of 38° C. It was thought that the activity of each preparation could be ascertained by filtering the liquid left at the expiration of the time selected, and then, after drying, weighing the residue left on the filter. The whole experiment was a failure, for the simple reason that what was left would not filter; the fluid positively declined to be filtered. It was put on the filtering-paper, and there it remained, hardly a drop passing through, even after standing twenty-four hours. It was not hurried in any way; it was allowed to take its own time about it, but the result was always the same. Different kinds of filtering-paper were

tried, and an attempt was made to humour it by folding the papers in various fantastic devices, but it was all to no purpose, and it refused to budge a drop. Finally glass-wool was experimented with, but it would not even go through that, and the whole thing had to be abandoned in disgust.

This plan having failed, another, or rather a modification of the former, was adopted. The white of egg, instead of being passed through a sieve, was cut up by hand into long, narrow, thin slips or slices. These pieces were not absolutely uniform either in shape or size, but as fifteen eggs were operated on at a time, and the whole mass was mixed up together, the error arising from this source could not have been very great. The weight of albumin taken for each observation was 1000 grains, as usual. The fluid was eight ounces of 1 per cent. hydrochloric acid of sp. gr. 1·150. The temperature was 38° C.; and the quantity of pepsin employed was one grain of each of the solid preparations and ten grains of those which were liquid. The observations in each case lasted for four hours. At the end of that time the liquid was filtered through muslin and carefully washed for thirty minutes with a small jet of distilled water. The muslin was then spread out on porous paper to absorb the excess of moisture, and allowed to remain exposed to the air at a temperature of 60° Fahr. for twenty-four hours. The albumen was scraped off the muslin and carefully weighed. The figure so obtained was subtracted from the weight originally taken, and in this way the quantity of albumin dissolved by one grain of each preparation was ascertained.

Thirteen solid specimens of pepsin were examined, some of English, others of French, German, or American manufacture. They were all active, but in many the proteolytic power was very small. Only four came up to the standard of the British Pharmacopœia. The name is evidently no

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guarantee of purity, for a specimen made by a well-known firm was represented by the figure 871, whilst another, sold under an equally well-known name, had to be satisfied with an award of 162, a state of affairs which is hardly satisfactory. The same pepsin is often sold under different names, according to the amount of impurity added. I have before me a table showing the exact quantity dissolved by one grain of all the best-known pepsins, but it would serve no useful purpose to publish it.

It may be doubted if the Pharmacopœial description of pepsin as "a light yellowish-brown powder" is a happy one, for one of the most active specimens was a preparation in scales. The pepsin supplied to hospitals is usually of poor quality.

In addition to the thirteen solid pepsins, I examined six liquid preparations, wines, essences, etc., and although ten grains were taken instead of one, the results were unsatisfactory, and the conclusion was that they were not very reliable, although none of them were absolutely inactive.

Having used the carica papaya largely in the treatment of various forms of dyspepsia, I determined to try it against the best pepsins, but found that under the conditions already indicated it was decidedly inferior in activity. I examined in all six specimens of papaw, but only two would come up to the Pharmacopœia test for pepsin. The best papain had about half the activity of the best pepsin. I do not say that in alkaline or neutral media the papains are not more active, but simply that, tested against the best pepsins and by the same methods, they do not give equally good results. Even in a neutral solution the best papain was not equal to the best pepsin in an acid solution. A papaw preparation which in a certain time dissolved 420 grains in an acid solution dissolved 476 grains in a quarter per cent. carbonate of sodium solution, and 535 grains in a neutral solution.

Another investigation had for its object the comparative values of different extracts of malt in the market, with reference to their power of converting starch into sugar. Eleven specimens were tried, and although some were extremely active, others were absolutely destitute of diastasic properties. One specimen, which had been supplied in large quantities to a hospital for more than two years, was perfectly valueless. It was dark in colour, and had clearly been prepared at a high temperature. The money wasted on this single drug would have sufficed to pay a skilled pharmacist, whose technical skill would have been a sufficient guarantee against so serious an error.

As another example of the enormous difference in the activity of different specimens or different preparations of the same drug, I may quote my experience of *Grindelia robusta* in the treatment of asthma. My first experience was made with a sample sent me by a well-known firm of American chemists. It was in every way perfectly satisfactory, and afforded my patient enormous relief. My supply being exhausted, the dispenser obtained a quantity from a firm of druggists in the City. This was a failure, and did little or no good. A specimen was then procured from another English firm; but this, although distinctly better, was a long way behind the American sample. Finally, a supply was sent over by the American firm, and this, although much better than the specimens obtained in England, was not up to the standard of their sample. The observations were made on the same patient; she was tested time after time without being informed of the change in the source of the drug, but she never failed to detect the substitution.

Every drug should, in hospital practice, be tested chemically by the dispenser and therapeutically by the physician, either in the wards or out-patient room. It is not at all

uncommon to come across drugs which are wholly inoperative. This is not always the fault of the wholesale chemist, for it must be remembered that he has no opportunity of witnessing the effect of the medicines, and if no complaint is made he naturally assumes that they are active.

PALATABLE MEDICINES.

The importance of giving medicines in a palatable form cannot be over-estimated. It is useless prescribing the right remedy if it is so nauseous that the patient cannot be induced to swallow it. There has been some improvement in this respect of late years, and it must be admitted that American chemists have in many instances given their European brethren a useful lesson. In pills, for example, the improvement has been very marked. A few years ago a pill was always a five-grain pill, however small the dose of the active ingredients might be. The modern chemist aims at making his pills as small as possible, and the pilule has to a great extent replaced the bolus. Pills, too, are now commonly varnished, and are sent out in dainty little bottles, and not in pill-boxes reeking of lycopodium powder and other abominations. The introduction of the tabloid has done much to facilitate the administration of medicines, and both doctors and chemists are keenly alive to the necessity for giving medicines in a palatable form.

The British Pharmacopœia is lamentably deficient in flavouring agents. There are a few syrups, such as the syrup of orange-peel, the syrup of orange flower, the syrup of lemons, and the syrup of tolu; there are one or two infusions, such as the infusion and the compound infusion of orange-peel, and that is about all. Spirit of chloroform, it is true, is a useful adjunct to many mixtures; but patients

are frightened when they see the word "chloroform" in a prescription, and raise all kinds of absurd objections, necessitating explanations which they neither understand nor appreciate; whilst the synonym "chloric ether" is equally liable to arouse their suspicions. The liquid extract of liquorice is useful in covering the salt and pungent taste of chloride of ammonium, but it can hardly be said to be a palatable preparation.

The foreign pharmacopœias are much better off in this respect than we are. The French *Codex*, for example, simply teems with flavouring agents. Looking down the list, it is seen that there are considerably over a hundred syrups alone; many of these, it is true, are complex in composition —the *sirop d'armoise composé* boasts of no fewer than eighteen constituents—and others contain active ingredients, but the great majority are simple palatable preparations useful as vehicles for the administration of nauseous drugs. Why should not our pharmacists give us something on the lines of the *sirop de violettes*, the *sirop des pensée sauvages*, the *sirop des fleurs de pécher*, or even the *sirop de guimauve*?

In the United States, elixirs of all kinds are largely prescribed. They are aromatic, sweetened, spirituous preparations, admirably adapted for flavouring purposes. What is known as the simple elixir may be prepared according to no less than eight different formulæ, so that the choice is ample. The chief ingredients are fresh orange-peel, alcohol, syrup, and water; but oil of cinnamon, coriander seed, star anise, nutmeg, carraway, cassia, cannella, and a number of other aromatic bodies, are frequently added. The simple elixir is colourless, but to produce various tints small quantities of cochineal, cudbear, or carmine are useful. The subject has occupied the attention of the Unofficial Formulary Committee of the British Pharmacopœia Conference, and good working formulæ are given, not only for

the simple syrup, but also for syrup of Virginian prune, one of the best of our flavouring agents, and for syrup of tar.

The following formulæ will be found useful for flavouring agents:—

Syrup of Fresh Lemons.

Take two large sound lemons; grate the peel and triturate with 2 ozs. of sugar of milk and a pint of hot simple syrup. Shake thoroughly, and, when cold, add the expressed juice of the lemons, ½ oz. of a 50 per cent. solution of citric acid, and sufficient syrup to bring the total bulk up to a gallon.

Chocolate Syrup.

Take 1 oz. of powdered chocolate, ½ oz. of powdered cocoa, 2 pints of simple syrup, and 3 ozs. of cold water. Mix the chocolate and cocoa powders, and make into a thin paste with the water. Heat the syrup to the boiling-point and add the paste slowly, stirring vigorously.

Coffee Syrup.

Take of Mocha and Java coffee of each 4 ozs. Put the mixed coffees into a percolator, and add boiling water to 3 pints. Let the coffee macerate for twelve hours, and then percolate to 2½ pints.

Raspberry Syrup.

Take of raspberry juice 1 pint, and of loaf sugar 24 ozs. Dissolve the sugar in the juice with the aid of heat, and strain.

ACCESSORY TREATMENT.

Every practical physician recognizes the value of what is commonly called "accessory treatment;" in other words, of

the importance of resorting to other curative methods besides the administration of drugs. In fact, some physicians go so far as to rely almost exclusively on accessory treatment, and give little or no medicine. The term "accessory treatment" is very wide, but by general consent is recognized as including all matters relating to diet, exercise, clothing, rest, amusement, and so on.

This subject is dealt with under the following headings:—

I. Diet.
II. Exercise.
III. Climate.
IV. Clothing.
V. Massage.

I. Diet.

Dietetic treatment is in many cases quite as important as treatment by drugs. The regulation of the diet alone will not enable you to dispense with the use of medicines. Take angina pectoris, for example. You may afford instant relief during a paroxysm by a fraction of a grain of nitro-glycerine or a few whiffs of nitrite of amyl, whilst the regulation of the diet would only prove beneficial by preventing the occurrence of dyspepsia and the formation of flatus. Indirectly, it would prove of use in removing certain predisposing causes and lessening the probability of a recurrence of the attack; but for the relief of the pain and the accompanying feeling of anxiety, nothing but medicinal treatment would prove of avail.

In cases of gout, and especially of diabetes, dietetics are even more important than treatment by drugs. We tell our gouty patients that they are not to indulge too freely in animal food, that they should abstain from *entrées* as much as possible, and that such things as pork, veal, and all salted and potted or tinned meats, which are more or less

indigestible, should be avoided. They may take an abundance of vegetables, but should eschew sugar and sweets and other articles likely to give rise to acidity. Their wines should be carefully selected, and port, sherry, and Madeira should be prohibited, although of late years the absurd doctrine has been put forward that gout is due, in many instances, to not drinking enough port wine. The best wine for a gouty man is claret, free from sugar, and devoid of acidity; but far better than any wine is good whisky taken only at meals, in strictly limited quantities, freely diluted with some effervescing water, such as lithia or potash.

In cases of diabetes mellitus, the sugar introduced with the food or formed within the organism is only imperfectly applied in the animal economy, the greater part being washed out of the body with the urine without undergoing any change. In the case of diabetics we prescribe a dietary free from sugar and sugar-forming substances. Practically, it comes to this—that the patient must not take sugar, and must not take starch. He may have as much meat as he likes in any form except liver, but he must avoid, not only sugar, but wheaten bread, rice, arrowroot, sago, tapioca, potatoes, carrots, parsnips, beetroot, pastry and puddings of all kinds, and fruit. He may drink dry sherry, claret, and hock, but must abjure champagne, port, and liqueurs. The great difficulty is in doing without bread; but he may have gluten bread, almond bread, or soya bread.

A good many tables or dietaries for the use of diabetics have been published, the best known being Pavy's, [illegible] Roberts', Germain-Sée's, Dujardin-Beaumetz's, [illegible] Cantani's, Ebstein's, and Düring's. They are [illegible] the same lines, differing only in matters [illegible]

I[illegible]

comm[illegible] [illegible] consumptives, or in those predisposed to

consumption, we give the patient as much meat as he can assimilate, with plenty of fat in a readily digestible form. He has rum and milk the first thing in the morning, bacon and coffee with plenty of milk in it for breakfast, white beans or lentils soaked in butter at dinner, and cream in all shapes and forms. Whenever there is an opportunity of getting it in, cod-liver oil is a convenient form of administering fat; and if the patient likes milk, we give him five or six pints a day, diluting it with soda-water, or lime-water, or anything that will make it digest more easily. The patient must have plenty of lime with his food, and it is a good plan to make a cordial composed of fresh eggs, the shells of which are dissolved in lemon juice and then beaten up with rum.

People who, although free from any organic disease, are distinctly below the average weight for age and height, and are incapable of much exertion, have to be catered for on the same lines. They must have plenty of meat, plenty of fat, and plenty of lime. Milk, cream, koumiss, cod-liver oil, extract of malt, sugar, and fruits are beneficial in these cases. Many dietaries for these patients have been published, but if there is not one at hand ready made, it is not a very difficult matter to improvise something which will meet the requirements of the particular individual.

For every person who wishes to get fat, there are a hundred who wish to reduce their weight. A woman who puts on flesh and loses her figure is the despair of her dressmaker, and gives herself up as lost. In this country stout women are at a discount, although in other lands they are highly esteemed. There are dietaries for the use of the corpulent, the majority aiming at knocking off sweets and starch. Some people adopt the Dancel system, and go in for a dry dietary; others pin their faith to Banting, others swear by Ebstein or Oertel, whilst many believe in

Schweninger's method. Some follow no system, but resort year after year to some particular place, such as Carlsbad, for a course of treatment. Many undoubtedly derive benefit from the limitation of food, but others injure themselves, perhaps permanently, by too rapidly reducing their weight.

Every medical man should understand something about cooking. He need not be an expert cook, but he should know, for example, all about sauces. He should be able to discuss, with a certain amount of intelligence, the modes of preparing *sauce blanche*, *sauce Hollandaise*, *sauce diplomate*, *sauce soubise*, *sauce béarnaise*, and other equally well-known sauces. The doctor, too, should know how to make coffee by means of an earthen percolator, and should have definite ideas on such subjects as hominy and porridge. He should be able to order a good breakfast, luncheon, or dinner, and should be well up in such subjects as kedgeree, chicken coquilles, macaroni, salads of all sorts, soufflés, and savouries.

The breakfast for a convalescent should include tea, coffee, or chocolate, porridge or hominy, poached eggs, ham or bacon well grilled, kippers, bloaters, or Finnan haddocks, cold meats, and marmalade or fresh fruit.

For luncheon he may have the choice of beef-tea or chicken-broth, both either hot or in the form of jelly, breast of fowl, sweets, savoury, cheese—Brie Camembert, Roquefort, or Gorgonzola by preference—fresh fruit, and a cup of black coffee.

At dinner he will have to fall back on Russian caviar—in jars, not in tins—oysters when in season, clear soup, fish, sweetbreads, chicken-breasts stewed in their own juice, cutlets, game, vegetables, and sweet omelette—with or without rum—a little cheese, fresh fruit, and coffee.

The doctor is sometimes called on to write a prescription for a complete dinner. The following are good examples

of menus for the month of May. The first at a good restaurant, would cost 7*s.* 6*d.* a head, and the second, 10*s.* 6*d.*

MENU I.

Potages.

Petite Marmite Viennoise.
Coulis d'Ecrevisses Marbre.

Poissons.

Filets de Sole Héloise. Whitebait.

Entrées.

Ris d'Agneau en Caisses Regence.
Tournedos à la Belle Fermière.

Roti.

Canneton à la Rouennaise. Salade.

Legumes.

Pommes Mireille.
Asperges d'Argenteuil Sce. Mousseline.

Entremet.

Mandarines Glacées à l'Impératrice.
Croûte Baron.

MENU II.

Potage.

Consommé Célestine.

Poisson.

Filet de Truite à la Georgette.

Entrées.

Fritot de Laittances Delmonico.
Noisette d'Agneau à la Marigny.

Roti.

Poulet de Printemps.
Salade de Saison.

Legumes.

Pommes Fondantes.
Petits Pois à la Bonne Femme.

Entremet.

Biscuit Glacé Bourdalouse.

There can be no doubt that good cooking and the careful selection of dishes is conducive to the maintenance of health. Brillat-Sararin, the suave and sympathetic gourmet, says:—

"It has been proved by a series of rigorously exact observations that by a succulent, delicate, and choice regimen, the external appearances of age are kept away for a long time. It gives more brilliancy to the eye, more freshness to the skin, more support to the muscles; and as it is certain in physiology that wrinkles—those formidable enemies of beauty—are caused by the depression of muscle, it is equally true that, other things being equal, those who understand eating are comparatively four years younger than those ignorant of that science."

The effect of habitually eating coarse and badly cooked food is at once apparent, not only on the skin, but on all the functions of the body. Good feeding is conducive, not only to bodily development, but to increased brain-work. Although there have been many exceptions, some very notable ones, it is as a rule from the well-fed classes that our eminent men arise.

Those who are interested in the subject of good feeding should read "Delicate Dining," by Theodore Child; "Real Cookery," by Grid; "Food and Feeding," by Sir Henry Thompson; and may also study with advantage Thackeray's chapter on "Great and Little Dinners" in "Mr. Brown's Letters to his Nephew." A more modern work is Dr. Thudichum's "Spirit of Cookery," an excellent book, which I can cordially recommend.

II. Exercise.

Exercise is of almost as much importance as the regulation of the diet and the administration of medicines in the treatment of many diseases.

The subject is clearly capable of being dealt with from many different points of view. Exercise is a potent factor in the maintenance of health, and it has often been said that a condition of perfect health without exercise is an

impossibility. Exercise, in addition to being a prophylactic, is a curative agent, and many diseases are appropriately treated by active or passive movement. On the other hand, excessive exercise—the abuse of exercise, that is—may produce the condition known as overstrain, and be the forerunner of disease.

Physiologically, exercise increases the oxidation of carbon, and perhaps also of hydrogen. It helps to eliminate water from the system by increasing perspiration. The pulmonary circulation is hurried, and the quantity of air inspired and of carbonic acid eliminated is increased. The action of the heart is increased in force and frequency, and the flow of blood through all parts of the body, the heart itself included, is augmented. Severe exercise increases the elimination of urea, but the increase both on an ordinary diet and on a dietary free from nitrogenous food is small. The quantity of urea passed during any period is largely dependent on the nitrogenous condition of the body at the time—that is, it varies according as a greater or smaller reserve of nitrogenous material has been accumulated. The influence of exercise on the nervous system is a matter which has excited much controversy, and by many it is maintained that it dulls the intellect, and is inimical to good work; but, on the other hand, it is urged that without exercise the mind soon becomes morbid, and is incapable of its highest efforts. There can be no doubt, however, that exercise greatly improves the appetite and facilitates digestion. Its influence on the sexual organs appears to be sedative in nature, and there is a general consensus of opinion that, as a rule, athletes are not "good performers." Exercise, if not excessive, increases the firmness, bulk, and power of the muscles. It is essential, however, that every period of muscular action or contraction should alternate with a period of relaxation, and it is

probably during the latter period that the nourishment of the tissue is provided. There must be a due relation between tension and repose, or impairment of nutrition results. It is a well-known fact that a man can do much more work when muscular action alternates with muscular relaxation. A blacksmith will continue to wield a hammer for an hour or more at a time, the strokes being delivered in rapid succession and without intermission; but if he were to attempt to hold the hammer at arm's length without the necessary interval of relaxation, he could sustain the strain for only a few minutes.

It is a somewhat humiliating reflection that few men over the age of forty manage to keep in anything like condition. Very few could run even a hundred yards at a decent pace without puffing and panting as if they had performed a remarkable and exhausting feat. From want of exercise, the muscles of the arms are flaccid and feeble, and those of the legs are in not much better condition. The tendency to put on flesh is another serious consideration, and most middle-aged men are a good two stone heavier than they ought to be. To a busy man, a man whose every moment is fully occupied, the cost of keeping in good form is a serious item of expenditure in the loss of time it involves.

The amount of exercise taken by a patient must be carefully regulated by his physical condition. It has been held by some authorities that the more mental work a man does the greater amount of physical exercise he requires. This may be all right on theoretical grounds, but it is found practically that a man who works hard with his brain, and at a high pressure, cannot take severe physical exercise. It is customary to tell middle-aged men who are actively engaged in the City all day that they would benefit by a ride in the Park before breakfast. A man of robust constitution will perhaps manage it, but many patients who

have made the attempt say that the effort is too great for them, and that the exercise tires them so much that they are unable to pay the same close attention to business as usual. The middle-aged Londoner rarely takes anything more violent in the way of exercise than a stroll down Bond Street. Walking is often considered a good form of exercise, but in reality it is not so, for, although the muscles of the legs are called into play, the arms are left uncared for. Moreover, walking in a town is almost an impossibility. A man cannot walk in a frock coat and tall hat, and his walking soon degenerates into a stroll. Even in the country, walking is not a very amusing form of exercise unless the walk is undertaken with an object or in pleasant company. Even the long walk is not satisfactory, for the distance covered is so short compared with what can be done on a bicycle, that there is naturally a feeling of disappointment.

If exercise is to do any good, it must take the form of amusement. The great merit of our national game of cricket is that it leaves no part of the body unexercised; arms and legs are equally used, and in batting and fielding alike every muscle is constantly brought into play. A good cricketer must exhibit quickness of vision and thought, sound judgment, boldness, brute strength, and great delicacy of muscular adjustment. Swimming is good, because it involves an equal use of the arms and legs, and, being practised in a state of nudity, there is no impairment to respiration. Lawn-tennis is good for strong, healthy young people of either sex, but for people of more mature years golf has many advantages. Of indoor amusements billiards is by far the best. The great disadvantage is that it has often to be played in public rooms which are unreasonably hot from being lighted with gas. Still it is an excellent exercise, and brings both arms and legs into play. When there is not

room in the house for a full-sized table, the end of a table six feet by four will afford ample opportunity for practising the spot stroke and nursery cannons, and of taking exercise in a pleasant form.

III. Climatology.

Change of air and the selection of a suitable health resort are important accessory modes of treatment.

Every autumn thousands of invalids rush off to the Riviera, and do not return to our shores until the summer is well advanced. They put up with high charges and a good deal of inconvenience for the sake of the sunshine and the beautiful climate. It is quite an open question if some of them would not do equally well if they wintered at St. Leonards or some other protected spot on the south coast of England. The difficulty is that our English watering-places are dull and ultra-respectable, and people, even when they are ill, want amusement.

The choice of a health resort for consumptives is a matter of vital importance. Formerly they were packed off to Madeira, but now the high Alpine stations find more favour, and the cry is for a high, dry climate, and not for a mild, relaxing situation.

Chronic bronchitics do badly in England during the winter, but their life is by no means an unpleasant one if they can afford to winter abroad.

People who are neuralgic or rheumatic soon discover that they cannot live on clay soil, and that their house should be built either on sand or gravel. The best situation for their residence is on the slope of a hill facing either due south or south-west. Rooms with a north aspect are practically uninhabitable, and there is no demand for them except as artists' studios.

A sea-voyage is one of the cheapest and most comfortable

means of obtaining fresh air at the disposal of the convalescent. Many lines lay themselves out to accommodate tourists and invalids. A three months' trip to Australia by the Cape of Good Hope, commencing about the end of October, is by no means unpleasant, although the return voyage by Cape Horn is to be avoided. One of the cheapest trips is from London to Malaga and back by the Hall line. It takes about a month, and the total cost, food and everything included, is £15 first class.

A person with an inherited taint of phthisis need not have a bad time of it, provided only that he has means. A well-known writer on consumption says: "Let those who have money, and to whom there exists no necessity for increasing their means, visit the interesting and beautiful parts of their own country. Let them go abroad and see what is new in institutions, wonderful in natural phenomena, grand in nature, and worthy of study in art. A long and healthy sea-voyage may convey them in renewed vigour to the calm and even climates of Tasmania or New Zealand, or the more bracing air of South Australia. Here let them live on horseback, and enjoy all that is new and exciting in these younger nations of the earth. The extremes of climate are not forbidden them, and a winter in Canada or a summer in Norway may lend them new vigour. In the pure and invigorating air of the upper regions of Mexico, Oregon, or Peru, in the exciting atmosphere of the Cape, are to be found, it is said, fresh pleasures to the senses, and stimulants to the nervous and muscular powers, such as must be experienced to be described. But man can bear and even profit by all extremes. The relaxing influence of Grecian or Roman plains, or of Egypt, the fresh, dry, and calm desert air, the life lived in tents, are spoken of by travellers as giving new vigour, from the healthy tone which is imparted to the nervous and muscular powers. We have

all met with men who have done much of this—cultivated men, and not mere idlers—wanderers of necessity and of liking, who have fought off the inherited taint, and who have lived to old age, hardy and vigorous, and 'temperate in all things.' And this, which need not be an altogether selfish existence, but may include many to help and much that is useful to do, is one of the high and pure enjoyments which, in certain cases, money is permitted to purchase."

The following is a list of some English seaside health resorts, with brief notes of their chief characteristics:—

1. South Coast.

1. *Ramsgate and Margate.*—Usually included amongst the South Coast watering-places, although, as a matter of fact, Margate faces the north. Margate is one of the most bracing places in England, and is especially adapted for scrofulous children. Ramsgate is more sheltered, but is still bracing.

2. *Deal and Dover.*—Deal is a quiet little place suitable for people in search of health without amusement. At Dover the arrival and departure of the boats is the attraction, but there is a fair sprinkling of soldiers.

3. *Sandgate* lives on the reputation of a past landslip and the promise of future improvements.

4. *Hastings and St. Leonards.*—These form practically one town. They face due south, and are admirably adapted to the requirements of phthisical patients during the winter. When there is any sun it shines at Hastings. The place is well looked after, and there seems a desire to encourage visitors, and not to drive them away. Hastings and St. Leonards are relaxing in the summer.

5. *Eastbourne* is largely frequented by well-to-do people. It is by no means cheap. It is bracing, and there is good whist and good golf.

6. *Folkestone* is a charming place in the summer. The

Lees form an extensive promenade. It is a favourite health resort with young ladies, who find the proximity to Shorncliffe and Hythe an advantage.

7. *Brighton.*—Brighton, or London-super-Mare, needs no introduction. It is bright and gay, and the women dress well. The railway accommodation is fairly good, and you can get a first-class return ticket for a month for £5.

8. *Southsea* is a suburb of Portsmouth. There is plenty to be seen in the way of big ships, and there are often military displays on the common. It is by no means a bad place even in the winter.

9. *The Isle of Wight* contains many valuable health resorts. Ryde is unattractive, and Cowes is dull except during the Cowes week. Ventnor does well for consumptives, and Shanklin and Sandown are also good. The most bracing place in the island is Freshwater. The great objection to the Isle of Wight is the poor railway service.

10. *Bournemouth.*—At Bournemouth you get two climates, one very relaxing down below, and another fairly bracing up above. It is a very pretty place, and old people often do well there.

11. *Weymouth* is killed by its railway fare. Compare Weymouth and Cromer. Weymouth is 145½ miles from London, and a Friday to Tuesday first-class return costs 33*s*. Cromer is 139 miles from London, and a similar ticket costs £1. Exit Weymouth.

12. *Torquay* is essentially a mild place, and is well adapted for invalids with delicate chests.

2. East Coast.

1. *Clacton-on-the-Sea*, *Walton-on-the-Naze.* — These are crowded in the season with people who come down for the day, but there is a steadily increasing residential population, and children derive much benefit from the bracing air.

2. *Dovercourt* is a little disappointing. The sands are not good, and there is no particular amusement for children.

3. *Felixstowe* is essentially a fashionable place in the season, and is largely resorted to for golfing purposes. Accommodation is scarce, and prices range high.

4. *Lowestoft* is intermediate in price and respectability between Yarmouth and Felixstowe or Cromer. It is admittedly a compromise, but it is distinctly bracing.

5. *Yarmouth* is a marvellous place for an invalid. It is bracing, and will ensure an appetite even in the most obstinate cases. It is vulgar, the essence of vulgarity, but there is plenty of amusement. A Friday to Tuesday return costs only 10*s*.

6. *Cromer* is charmingly situated, and, like Margate, faces due north. It is renowned for its sands and the beauty of the walks.

7. *Scarborough* has the reputation of being a fashionable place, and the hotel charges are high in proportion. It is far less bracing than either Yarmouth or Cromer.

8. *Whitby* is a picturesque old town on the Yorkshire coast, presenting many points of interest. It is largely frequented during the season, and is cheaper than Scarborough.

9. *Saltburn* is blessed with a magnificent reach of sands, so dry and hard that it affords facilities for cricket, lawn tennis, and other games. It is a good place for children.

10. *Bridlington* is a useful seaside resort, and every season there is an influx of something like 40,000 visitors.

3. West Coast.

1. *Ilfracombe* is said to be the healthiest Devonshire watering-place. It is a good resort for convalescents, and a good many people take up their residence there during the [illegible]

2. *Weston-super-Mare* is a quieter and smaller place than Ilfracombe, but there are excellent facilities for bathing.

Other places on the West Coast are Swansea and the Mumbles, Llandudno, Colwyn Bay, Southport, Blackpool, Morecambe, and the Isle of Man.

4. Inland Health Resorts.

There are not many inland health resorts in England, but some of them are well adapted for the treatment of certain diseases.

1. *Bath* has been noted as a health resort for over two thousand years. The springs are by far the hottest in England, and there is a constant supply of water at 120° F. These waters are employed in chronic rheumatism, chronic gout, and in all chronic joint affections. Patients go there for much the same reason that they go to Aix-les-Bains. At Aix, however, the living is cheaper, and there is more amusement. Bath is essentially relaxing, and many patients after their course find it advantageous to go to Buxton.

2. *Buxton* is situated at a thousand feet above the sea-level, and the air is pure and bracing. The water issues from the limestone rock at a temperature of 82° F.

3. *Matlock* is not far from Buxton, and is resorted to by the gouty and rheumatic.

4. *Leamington* and *Cheltenham* are good places of residence for old people, but their popularity is on the wane, and they no longer attract crowds of visitors as they did years ago.

In Scotland the chief health resort is Strathpeffer; whilst in Ireland there are Bray, Lucan, Glengariff, Blarney, Lisdoonvarna, Donegal, and Portrush.

The student would do well to mark off on a map the various health resorts of England, Scotland, Ireland, and Wales.

IV. Clothing.

For the efficient maintenance of health strict attention must be paid to dress. The prognosis is indeed bad when a woman ceases to take a rational interest in what she wears. The chief materials employed in making clothes are cotton, linen, jute, wool, silk, leather, and indiarubber. These, of course, simply form the substratum, for the materials employed for purely decorative purposes are endless in number and vary from season to season. Cotton garments wear well, do not shrink in washing, do not readily absorb moisture, and conduct heat less readily than linen, but with much greater facility than wool. Cotton is cheap and durable. It is the sole constituent of calico, but merino is cotton with the admixture of from twenty to fifty per cent. of wool.

Linen is smoother than cotton, and absorbs moisture and conducts heat somewhat more readily. It is often starched, which serves to give it a glossy appearance.

Jute, which is obtained from *Corchorus capsularis*, comes to us from Russia and India, and is largely employed to mix with other fabrics.

Wool absorbs water readily, and is a bad conductor of heat, so that it always feels warm. It is not easily penetrated by draughts, and is the typical form of dress for rheumatic and neuralgic patients. It is the best material for blankets, preventing the radiation of heat during the night, and in the early hours of the morning. The Jaeger clothing, of which one hears so much, is formed of carefully selected wool which does not irritate the skin. The great objection to its universal employment is that, if sent to the ordinary laundress, it shrinks, and after a few washings is rendered utterly unfitted for use.

Leather is chiefly used for boots, but is sometimes employed for leggings, accoutrements, coats, and trousers. It is very warm, and as the wind cannot penetrate it, it is especially adapted for cold climates. The thinner varieties are perfectly supple.

Waterproof clothing has the reputation of being "heating." It prevents the evaporation of perspiration, and in a short time becomes unbearable. It is best adapted for overcoats, and for occasional wear during a shower of rain. When spread on damp ground it serves as a protection to soldiers and others who are obliged to camp out. It cracks in cold climates, and is apt to become soft and sticky when exposed to excessive heat.

With regard to the minor modifications of clothing it is difficult to offer any opinion, and the subject cannot be dealt with on scientific principles. It requires an intimate knowledge of women to understand the principles on which they are pleased to dress themselves. Practical experience of such matters will be found useful.

V. Massage.

Massage is a scientific method of treating certain forms of disease by systematic manipulation.

The following are the chief movements:—

1. *Effleurage*—a stroking movement made with the palm of the hand, which is passed with various degrees of force over the surface of the body.

2. *Pétrissage* consists essentially in picking up a portion of the soft tissues with both hands, or the fingers of one hand, and subjecting it to firm pressure, rolling it at the same time between the fingers, or the fingers and the adjacent parts.

3. *Friction*, or *Massage à frictions*, is performed with the tips of the fingers, which keep up a rotatory movement.

4. *Tapotement* is a kind of percussion made with the tips of the fingers, the palm of the hand, the back of the half-closed hand, or the ulnar, or radial border of the hand.

These movements are combined in various ways, and the treatment has been found useful in gout, rheumatism, obesity, constipation, insomnia, and some forms of paralysis.

Massage is undoubtedly a valuable mode of treatment, but of late the subject has fallen into discredit in consequence of certain immoral practices which are carried on in massage establishments. The whole matter has become a public scandal, and in the interests of morality no hesitation is felt in exposing the methods which are pursued in these houses.

It may be as well to say that there is no difficulty in finding these "Massage Shops," for advertisements are to be found daily in the fashionable papers. In London there are half a dozen houses within a stone's throw of Piccadilly Circus, and there are hundreds of women engaged in the trade. When one place gets too hot for them they shift their quarters, and not infrequently change their names.

Some of these houses are to be found in the main thoroughfares, whilst others are conveniently situated in the smaller streets, but always in close proximity to one or other of the large centres of traffic. There is a striking resemblance between these establishments, and although there may be individual differences in matters of detail, they are practically all run on the same lines. There is nothing to attract the attention of the casual passer-by, although, to the initiated, the neat little brassplate, with the word "Massage" or "Manicure," sufficiently indicates their purpose. Most of the massage rooms are situated on the first floor, usually over the shop, but in one or two cases

the whole house has apparently been retained. The outer door remains open from eleven in the morning until half-past seven in the evening or perhaps even later, Sundays included. It is found, by experience, that visitors to these resorts have a deep-rooted objection to be kept waiting on the doorstep where they might be seen by any one passing. The inner door on being pushed open, rings an electric bell which gives timely notice of the advent of the customer. When there is no inner door, one of the stairs is fitted with an electric alarum which answers the same purpose. Especial care is always taken that customers do not meet, and when a visitor is about to depart, and the bell rings, he is requested to wait until the coast is clear.

On arriving at the top of the stairs, the patient is received by the proprietress, who, in massage circles, is known as "madam." This title is not to be taken as an indication that she is of foreign origin, but simply that she performs a well-recognized function. She is usually a woman of mature age, characterized by a soft voice and an ingratiating and sympathetic manner. She is keenly alive to the requirements of her patrons, and is only too delighted to accede to their slightest wish. The majority of the customers, who, as a rule, are men about town, have nothing the matter with them, except perhaps a superfluity of cash, and make no particular secret about the object of their visit. Some of them confine their attention to some one particular establishment, whilst others seek variety. When they are tired of one massage girl they select another. The only question put to the novice at his first visit is whether he would like a bath, or would prefer massage only. Madam always recommends a bath prior to the massage, and for obvious reasons, the fee for a bath and massage being one guinea, whilst massage alone, of half-an-hour's duration, can be obtained for the moderate sum of half a guinea.

Should the candidate elect to have a bath, he is ushered by madam into a room furnished with a dainty bed or couch and ornamented with a profusion of plants and gaily coloured decorations. Many of these chambers are veritable works of art, and everything is done to make the visitor comfortable. Madam informs him that the young lady will be with him in a minute, and after requesting that he will be good enough to undress completely, gracefully retires, and is not seen again until after the operation.

When the visitor has disrobed, a knock is heard at the door, and the so-called masseuse makes her appearance. She is usually quite young, and is pleasing to behold. She is attired in a more or less fancy costume which leaves her arms fully exposed. She is by no means shy or of a retiring disposition, and, after carefully locking the door, conducts the patient to his bath, which may be situated in the same room or in an adjacent chamber or alcove. The bath, which is a full-length one, is warm and is pleasantly scented with pine extract or some other perfume. Connected with it is an ordinary battery, two metal plates, one at either end serving to conduct the current. Should the visitor not wish for a bath, this preliminary stage is dispensed with, and after undressing he simply reclines on the couch. It is not necessary to enter into details respecting the mode of manipulation pursued. Needless to say the young lady makes herself as agreeable as possible, knowing full well that the amount of the tip which she expects to receive will depend largely on the satisfaction which she is able to afford her visitor.

These practices have been the deathblow to legitimate massage, and a useful method of treatment has unfortunately fallen into undeserved disrepute. The so-called massage certificates, of which some young women are so proud, are not worth the paper on which they are written.

CERTAIN CURES.

There are certain systems of cure concerning which the student should have some knowledge. The number is constantly on the increase, but the following list may serve a useful purpose:—

1. **The Water Cure.**—This is practically identical with hydropathy, and is the treatment of disease by the use of water internally and externally. You have water when you get up, water for breakfast, water for dinner, water for tea, and water when you go to bed. In the intervals you have cold baths, douches, and wet packs. It is useful in rheumatism, insomnia, gout, headache, and menstrual disturbances. In persons not accustomed to it, it induces a craving for whisky.

2. **Mind Cure.**—The alleged cure of disease through mental operations. It is pretty much the same as "cure by suggestion."

3. **Faith Cure.**—The system or practice of attempting or pretending to cure diseases by religious faith and prayer alone. It is said to differ from "mind cure" in that the faith-curers have no mind, whilst the mind-curers have no faith.

4. **Grape Cure.**—A cure for pulmonary tuberculosis and other diseases by the ingestion of large quantities of grapes. It is carried out chiefly at Meran, the ancient capital of the Tyrol. The patient takes from three to eight pounds a day, the skins and stones being rejected. They act as a gentle laxative. It is in reality a grape-sugar treatment. At one time only a little bread was allowed in addition to the grapes, but of late this rule has been relaxed, and now the patient is practically at liberty to eat and drink anything he likes,

with the exception of fat and tough meats, hard-boiled eggs, pickled meats, potatoes, and beer. Milk is allowed in unlimited quantities. The patient usually gains weight, and finds that his capacity for exertion increases.

5. **Strawberry Cure.**—This is on much the same lines as the grape cure, but it must be remembered that in certain exceptional individuals strawberries produce a persistent urticaria.

6. **Potato Cure.**—This differs in every way from the cures last mentioned. It is a mashed-potato cure, and is a method of treating foreign bodies in the alimentary canal by the ingestion of mashed potatoes. The irritant becomes imbedded in the mass, and is expelled with safety. A modification of this is the "rolley-polley pudding cure."

7. **Milk Cure.**—In this form of treatment everything but milk is rigidly excluded, the patient receiving three or four times a day, at strictly prescribed intervals, from a half to a whole cupful of skimmed milk, the vessel having been previously warmed by immersion in hot water. It is said to be useful in chronic gastric ulcer.

8. **Whey Cure.**—This is a modification of the above, but you take whey instead of milk.

9. **Koumiss Cure.**—Koumiss is fermented mares' milk. The treatment is extensively employed in cases of phthisis, and many striking cases of recovery have been reported. It necessitates a visit to the Steppes of European Russia and Central and South Western Asia. Some years ago such an undertaking in the case of an invalid would have been an impossibility; but now, thanks to modern facilities, it is possible to reach the town of Drenbourg on the borders of South Western Asia with but thirty-three hours' railway travelling. It must be remembered that Petersburg can be reached from London for £5. The railway journey from Petersburg to Moscow occupies only a night, and the

travelling is so luxurious that not the slightest inconvenience is experienced. The train leaving Moscow in the evening reaches Nijni Novgorod in the early morning. From Nijni the trip down the Volga to Samara is accomplished in forty-three hours in a large, fast, and comfortable steamer, and from Samara it is only fifteen hours' railway journey to Drenbourg. There are several koumiss establishments in the neighbourhood, of which particulars can be obtained without difficulty. The climate is magnificent, and the life is most interesting. The air is so pure and fresh that the sufferer feels invigorated, and in a very short time improves in appetite and gains flesh.

10. **Shaking Cure.**—This is a treatment of paralysis agitants by means of a vibrating armchair advocated by Charcot. In default of the orthodox apparatus a London omnibus will serve the purpose. It is not adapted for patients with stone in the bladder.

11. **Hunger Cure.**—The scientific name for this is Nestiatria (from νηστεία, "a fast," and ἰατρεία, "treatment"). You go to any fashionable hotel furnished with electric light and a lift, and dine at the *table d'hôte*. It is largely practised at England seaside resorts during the season. It is expensive, but is an infallible cure in the case of the man who is always complaining that he has no appetite.

12. **Schroth's Cure.**—This is a dry method of treatment. The food is freed from moisture, and the patient has nothing to drink except one small glass of hot wine night and morning. The dinner consists of thick boiled vegetables dried, and seasoned only with pepper and salt, the rest of the day nothing but dry bread being taken. The patient suffers much inconvenience, febrile symptoms are induced, appetite is lost, and there is usually intense prostration. Physiologically the effect is to produce concentration of the serum of the blood with accelerated diffusion between the

blood and the fluids of the parenchyma. It is not quite clear what good the treatment does, but it is said to be a specific for a cold in the head. It is also useful in obstinate syphilis, in chronic articular rheumatism with effusion in the knee-joint, and in chronic peritoneal effusion.

13. **The Schott Cure.**—The Schott treatment of chronic diseases of the heart is practised at Neuheim. It is carried out by a combination of (1) baths containing various mineral substances, and free carbonic acid gas in solution, and (2) a series of graduated gentle exercises or gymnastics. The baths contain one per cent. of chloride of sodium, with one part in a thousand of chloride of calcium, and a certain amount of free carbonic acid gas. The best results are obtained in cases of cardiac dilatation due to overwork or mental worry, but it is also useful in fatty infiltration of the heart—not fatty degeneration—accompanying general obesity.

14. **The Kneipp Cure.**—This is carried out in the little town of Wörishofen in Southern Bavaria. Its originator, Sebastian Kneipp, the son of the village shoemaker, is now the pastor of the parish. The system consists in an absolute return to the rudimentary principles and customs of humanity. It is chiefly a cold-water system, carried out with the aid of the River Wettbach. The Kneippists abjure shoes and stockings, and walk about in the long wet grass with bare feet and as little clothing as is compatible with decency.

15. **The Schweninger Cure.**—Respecting this method of treatment it is difficult to speak with any certainty. Prof. Schweninger is physician to Prince Bismarck, and is said to have formulated a strict dietetic regimen which is applicable to the treatment of obesity. It is probable that it is not very different to the system of treatment which in this country is called Bantingism, after the celebrated undertaker.

MODES OF ADMINISTRATION OF MEDICINES.

The method of administering medicines is a subject of practical importance. There are several modes and channels by which they may be introduced into the system, of which the following are the most important:—

I. By the Mouth.
II. By the Stomach.
III. By the Rectum.
IV. By the Skin.
V. By Transfusion.
VI. By Inhalation.

These different methods will now be considered in detail.

I. By the Mouth.—This is the first and simplest way. If the drug is administered by the mouth it may be given—

A. As a Liquid.

(1) *By itself.*—As, for example, when we give cod liver oil or castor oil or extract of malt alone and unmixed with any other substance.

(2) *In Water.*—Many medicines are added to water before being taken, because they are too pungent to swallow alone. We have examples of this in sal volatile and ammoniated tincture of quinine.

(3) *In Milk.*—We give medicines in milk when it covers their taste, and especially when they are precipitated on being mixed with water. The ammoniated tincture of guiacum is best given in milk.

(4) *As a Mixture.*—This is the favourite method, when several drugs are given together. In addition to the active ingredients there is often something added to impart to the mixture an agreeable taste. Mixtures are usually made up

with water to an ounce, so that the dose is two tablespoonfuls. It is hardly necessary to give examples of mixtures, but the quinine mixture, the gentian and soda mixture, and the perchloride of iron mixture found in every hospital pharmacopœia, may be quoted. Some mixtures are official; for example, the ordinary *mistura sennæ composita*, or black draught.

(5) *As a Natural Water.*—These are in reality mixtures, but compounded by nature, and not the chemist. A good example is the Hunyadi János water, now so largely used as an aperient medicine.

B. As a Solid.

Some drugs cannot be given in the liquid form because they are insoluble in fluids. In other cases, as for example, when a patient is travelling, it is more convenient to have the medicine in a solid form. Solid medicines may be given—

(1) *As Pills.*—Pills vary much in size. The old-fashioned chemist delighted in a large five-grain pill, but a pilule is preferable to a bolus, and the smaller they are the better. Pills are usually round, but many people prefer them oval. The old-fashioned pill was usually sent out in a box containing lycopodium powder, to prevent them from sticking together; but pills are now usually coated. The oldest form of coating is silvering, the pill being shaken up in a box with silver leaf. The gilded pill is a variety of this, gold leaf being used to cover the pill, especially in the case of dinner pills. Sugar-coated pills are made in the same way as the sugar-coated almonds of the confectioners, the pills being placed in a hot copper receptacle, with powdered sugar, and quickly rotated. In France, sugar-coated pills are called *dragées*, and when very small, *granules*. French chalk is sometimes used to coat pills, but it is not a good coating, and many pills so coated may be

boiled in water for half an hour without dissolving their covering. Gelatine-coated pills are covered by being stuck on the end of pins and dipped into the solution. Lead and opium pills should not be treated in this way, as the gelatine becomes converted into a leathery mass which nothing will dissolve. Probably the best of coatings is a simple transparent varnish. Pills which have been long kept become hard and insoluble, and fail to exert any action, being expelled with the motions unchanged.

(2) *As Powders.*—Some drugs are commonly given as powders, but it is not a popular form of administration. A patient who is insensible will often swallow a powder placed on the back of the tongue when it would be almost impossible to get him to take a pill. Children are often given powders in jam, but it is not a good form of administration. The best way to give a powder is to enclose it in a capsule, or have it made into a pill; for example, Dover's powder is commonly given as a pill. Powders are often given in "cachets," made of flour and water.

It is a circumstance worth noticing that drugs administered in the form of powder often produce effects quite different from or even entirely opposed to their ordinary physiological actions. This arises from the lodgment of fine particles of the powder in the mucous membrane of the stomach or intestines, where they act as gastro-intestinal irritants. It is well known that many fruits act as purgatives or laxatives from the stimulus afforded to the peristaltic action of the intestine by the little seeds which they contain, and we have a closely analogous condition in the case of powders. Take tannin, for example; usually it acts as an astringent, and is given in cases of diarrhœa, but if administered in the form of a capsule, so that the minute particles are set free in contact with the mucous membrane of the alimentary tract, it may produce vomiting or diarrhœa.

(3) *As Triturations.*—What are called "triturations" are largely employed in the United States, and are official in the United States pharmacopœia. They are prepared by rubbing up together so as to form an intimate admixture, ten parts of the drug by weight, and one hundred parts of sugar of milk in moderately fine powders. There is no doubt that many insoluble drugs are rendered much more active by this minute subdivision, probably because they are brought into a condition in which they can be readily absorbed. These triturates are commonly put up in the form of tablets or tabloids, prepared by compression. The most popular of the tablet triturations are those containing the equivalent of a minum of tincture of aconite in each, the one hundredth of a grain tablets of perchloride of mercury, the third of a grain grey-powder tablets, the tenth of a grain sulphide of calcium tablets, and those containing minum doses of tincture of nux vomica or tincture of belladonna. As the dose is small they must be given frequently to obtain their full effects, but there is no doubt as to their therapeutical activity.

(4) *As Tabloids.*—Compressed tabloids afford a convenient mode of giving many drugs. The dose is accurately graduated, so that all trouble of weighing or measuring is avoided. Tabloids such as those of chlorate of potash, which are intended as local applications to the throat and adjacent parts, should be sucked; they have all the advantages of a continuous gargle. Tabloids which are intended to produce a constitutional effect should be swallowed whole. When the tabloids contain nauseous drugs they are coated or varnished. They have many advantages over pills, and are largely prescribed.

The word "tabloid," is protected, and should not be employed as a synonym for "tablet."

(5) *In Capsules.*—Many drugs are conveniently given in

capsules. There are two kinds, empty capsules and filled capsules. The empty capsules are made in various sizes of gelatin, and are furnished with a little cap or lid which takes off to admit of the capsule being filled, after which the lid is replaced. Ready-filled capsules are usually ovoid in shape, and are convenient for the administration of nauseous drugs, such as cubebs and copaiba. Large flexible capsules are sometimes met with, and the argument usually employed is that they are smaller than an oyster and just as easy to swallow. A variety of capsule is the "palatinoid," a gelatin envelope, which is sometimes divided by a septum to form what is called a "bipalatinoid." These are, of course, "coined words."

(6) *As Lozenges.*—The lozenges of the British Pharmacopœia are made with refined sugar and gum acacia. They are hard and angular, and often irritate an inflamed or congested throat. A better plan is to make lozenges with a fruit-paste basis, either black or red currant being adapted for the purpose.

The custom of stamping the lozenge with letters, indicating its composition, is a good one. "MA" means muriate of ammonium, "BA" benzoic acid, "CB" cubebs, "P" chlorate of potash, "T" tannin, and so on. At one time effervescing lozenges were employed, but they seem to have dropped out of use, although they are still sometimes used for the extemporaneous preparation of lithia water and Vichy water. Pastils are made with "glyco-gelatine," which is a mixture of gelatine and glycerine, flavoured with orange flower and coloured with carmine.

(7) *As Confections.*—A confection or electuary is a convenient form of administration when the drug is not readily soluble, and has to be given in large doses. We have familiar examples in confection of sulphur, and confection of senna.

II. By the Stomach.—Medicines taken by the mouth are absorbed chiefly by the stomach, but, under certain circumstances, it is found necessary to introduce them directly into that receptacle. A patient may have taken a narcotic poison so that he is unable to swallow, and, in such a case, the stomach is usually washed out and the antidote given by means of the stomach pump or, better still, by a stomach-tube used as a syphon. In cases of obstruction of the œsophagus, say from malignant disease, the patient may have to be fed with the stomach-tube, or possibly an incision may have to be made through the abdominal walls and the stomach itself laid open.

III. By the Rectum.—This mode of introducing remedies is frequently resorted to. If the bowels refuse to act, it is better to give a simple enema of a pint or a pint and a half of soap and water than to wait for the slower action induced by a purgative pill. Again, if a child suffer from thread-worms, an injection of salt and water, or of infusion of quassia, or of a teaspoonful of tincture of perchloride of iron in a pint of cold water, will soon get rid of them. In cases of obstinate diarrhœa a small injection of starch and opium speedily affords relief. Nutritive enemata are almost universally resorted to in cases of gastric ulcer, to rest the affected viscus. They usually consist of beef-tea and brandy, with perhaps a few drops of laudanum. In many cases it is found advantageous to predigest the food with pancreatin. Nutritive enemata must be small, and should not exceed three or four ounces, or they will not be retained. Every few days the bowel should be washed out with a pint or more of tepid water, or the rectum will become irritable. I have kept a patient alive for fifty-six days by rectal feeding alone.

Suppositories of all kinds are used for introducing drugs into the rectum, and opium suppositories are usually given

to induce sleep after severe operations. When nutritive injections are not retained, suppositories containing peptones may be resorted to with advantage.

IV. By the Skin.—Drugs may be introduced into the circulation through the skin.

(1) *Hypodermically.* The best method is the subcutaneous or hypodermic. For example, we inject morphine to relieve pain, atropine to check profuse sweating, apomorphine to evacuate the contents of the stomach, pilocarpine to produce sweating, strychnine to stimulate paralyzed muscles, and so on. The following list will give some idea of the drugs commonly employed hypodermically.

Drugs commonly employed hypodermically.

Drug.	Origin.	Uses.
Morphine.	Opium.	To allay pain, relieve spasm, and induce sleep.
Apomorphine.	Morphine.	As an emetic.
Atropine.	Belladonna.	To check sweating and, in combination with morphine, to allay pain.
Pilocarpine.	Jaborandi.	To produce sweating.
Ergotin.	Ergot.	To induce contraction of the uterus.
Strychnine.	Nux Vomica.	To restore power to paralyzed muscles.
Aconitine.	Aconite.	In the treatment of neuralgia.

Drug.	Origin.	Uses.
Curarine.	Curare.	To paralyze motor nerves in the treatment of tetanus.
Ether and brandy.		As stimulants in collapse.

This is not by any means a complete list, and many other substances—digitalin, muscarine, homatropine, tuberculin, and tuberculonidin, for example—are often given subcutaneously.

There are many advantages in giving drugs hypodermically; a small dose will suffice, the stomach is not deranged, and the action is more prompt.

In the majority of cases the needle of the hypodermic syringe is introduced just under the skin. Ergotin, however, produces a good deal of irritation, and it is best to push the needle in deeply so as to make the injection into a muscle.

It is not safe to employ the hypodermic solutions of the British Pharmacopœia unless they are freshly prepared. If they are kept any time they undergo decomposition, a fungus forms, so that when injected under the skin they give rise to a good deal of irritation. Most people, instead of keeping the pharmaceutical solutions, prepare the solution as required by dissolving a tabloid in water. Who originated this idea is not quite clear, but probably the credit is due to Dr. H. Augustus Wilson of Philadelphia, the author of a paper published in 1881, entitled "Soluble Compressed Pellets: a new form of Remedies for Hypodermic use, and applicable to Ophthalmic and General Medication."

(2) *Inunction.*—Another way of introducing drugs into the system through the skin is by inunction.

The mercurial, or blue ointment, is rubbed into the

armpits and other parts of the body in the treatment of syphilis, and the oleate of mercury is also largely employed for the same purpose.

The innunction of oil is sometimes practised in the case of consumptives who cannot take fat in the ordinary way, and this mode of treatment is especially adapted for children.

That the innunction of castor oil will act as a purgative is well known.

Liniments rubbed into the skin not uncommonly induce the constitutional effects of the drug, and the same may be said of plasters. A good belladonna plaster will dilate the pupils and produce a rash all over the body.

Drugs are readily absorbed from the surface of hot, moist poultices. If a linseed-meal poultice is ordered for a baby, it is not safe to sprinkle it with laudanum, or enough may be absorbed to induce narcotic poisoning.

Before the introduction of the hypodermic method, it was customary to raise a blister and dust the powdered drug over the raw surface.

V. By Transfusion.—Drugs may be introduced directly into the circulation, a vein being opened for the purpose. Saline solutions are injected in this way in the collapse of cholera. The value of transfusion of blood from arm to arm in cases of post-partum hæmorrhage is well known, but it is probable that the transfusion of a saline fluid would prove equally efficacious. In cases of poisoning the injection of saline fluids is useful by reducing the percentage of poison in the blood. The following is the best formula:—

Saline Solution for Intravenous Injection.

Common salt	1 drm.
Bicarbonate of sodium	4 grs.
Chloride of calcium	1 gr.
Water	20 ozs.

[redacted]

When the requisite materials are not at hand for making an intravenous injection, this fluid may be introduced into the peritoneal cavity, from which it is absorbed. No apparatus is needed beyond a piece of indiarubber tubing with a cannula at one end and a funnel at the other. The tube should be rendered antiseptic by washing it out with boracic acid, the solution being boiled for a few minutes and then allowed to cool down to 100° F.

Further details of this method of treatment will be found in a subsequent article.

VI. BY INHALATION.—Inhalations are commonly employed for their local effect on the throat and chest; but they are often useful in producing the constitutional effects of the drug. There are many different kinds of inhalations, both moist and dry. A familiar example of the moist inhalation is afforded by putting a teaspoonful of Friar's balsam in a pint of water at 135° Fahr., and inhaling the steam. Ten drops of tincture of iodine added to water in the same way will produce an iodine vapour, which is useful in phthisis and chronic bronchitis. Then sometimes we draw air through a tube containing a little plug of cotton-wool moistened with oil of eucalyptus or pure terebene or pinol, and this affords a good example of a dry inhalation. The common menthol inhalers used for relieving cold in the head come under this category.

The following inhalations are commonly prescribed for use with the ordinary steam spray apparatus:—

(1) Alum—15 grains to an ounce of water in chronic catarrhal affections of the pharynx, and in chronic bronchial affections attended with much secretion.

(2) Tannic acid—10 grains to the ounce of water in laryngeal ulceration, and in slight hæmorrhage from the mouth and throat.

(3) Tincture of perchloride of iron—15 minims to the ounce in chronic pharyngitis and laryngitis.

(4) Ipecacuanha wine—equal parts of the wine and of warm water in chronic bronchitis and emphysema, but not in asthma.

(5) Sulphate of zinc—4 grains to the ounce in bronchial catarrh with excessive secretion.

(6) Chlorate of potassium—a saturated solution in water in catarrhal laryngitis and chronic bronchitis.

(7) Iodine—15 minims of the liquor in an ounce of water in cases of fœtid secretion from the lungs.

(8) Conium—half a drachm of the succus, with 20 minims of solution of potash to an ounce of water in the irritative cough of phthisis.

(9) Arsenic—5 minims of the liquor to the ounce of water in cases of chronic consumption.

(10) Turpentine—2 minims to the ounce of water in cases of gangrene of the lung and fœtid secretion from the bronchial tubes.

Other drugs, such as eucalyptus, pure terebene, and pinol, are often used as inhalations either alone or mixed.

For use in an atomiser, liquid vaseline specially prepared for this purpose will be found convenient as a basis. Various combinations of pure terebene, pinol, oil of cubebs, and oil of sandal-wood diluted with the liquid vaseline may be employed. The following are good formulæ—

1.	Pure terebene	1 dr.
	Oil of cubebs	1 dr.
	Oil of sandal wood	1 dr.
	Liquid vaseline	to 1 oz.
2.	Iodoform	20 grs.
	Creasote	10 mins.
	Oil of eucalyptus	20 mins.
	Ether	1 dr.
	Oil of sweet almonds... ...	to 1 oz.

[redacted]

3.	Tincture of iodine	1 dr.
	Glycerine	1 oz.
	Alcohol	to 3 ozs.
4.	Compound tincture of benzoin ...	1 fl. oz.
	Glycerine	1 fl. oz.
	Alcohol	to 3 oz.

The fumes of chloride of ammonium are often inhaled, the apparatus usually consisting of two bottles, one containing ammonia and the other hydrochloric acid. The vapours mix, and are then washed by being drawn through water in a wash bottle to which, if thought desirable, oil of eucalyptus or some other similar substance may be added.

As an example of a drug used in the form of a vapour to induce a constitutional effect, we may mention the inhalation of calomel in the treatment of syphilis.

Many drugs are smoked not merely as a luxury, but with the view of inducing some definite therapeutical effect. The following is a list of some drugs which are commonly smoked.

Drugs which are smoked.

Drug.	Origin.	Uses.
Tobacco.	Leaves of Nicotiana tabacum.	For its sedative effect.
Indian hemp.	Cannabis indica.	As a luxury, and for the mental excitement it produces.
Opium.	Juice of papaver somniferum.	To allay cough in phthisis, and in many painful affections.

Drug.	Origin.	Uses.
Lobelia.	Lobelia inflata.	As an anti-spasmodic, especially in asthma.
Cubebs.	Cubeba officinalis.	As an expectorant in chronic bronchitis, and in hay-fever, coryza, etc.
Arsenic.		For its constitutional effect in cases of phthisis.
Stramonium.	Datura stramonium.	In cases of asthma, to relieve the dyspnœa.

"British herb tobacco" consists chiefly of the leaves of coltsfoot (*tussilago farfara*), a native plant, found growing in profusion in all parts of the country.

Some of these drugs are commonly smoked in a pipe, and others are more conveniently smoked in the form of a cigarette. The opium-pipe is quite different in shape from the pipe used for smoking tobacco, the bowl being in the middle of the stem.

Dr. Reginald Thompson advocates the use of various forms of cigarettes not only for allaying the irritative cough of the early stages of consumption, but for the relief of the dyspnœa of asthma, and bronchitis. The cigarettes are made by dipping sheets of thin Swedish paper in preparations of the drugs. The following is Dr. Reginald Thompson's formula, the quantity sufficing to make sixty-four cigarettes:—

Tincture of tobacco	10 drs.
Tincture of conium	2 drs.
Tincture of lobelia	2 drs.
Tincture of cannabis indica	32 mins.
Extract of opium	1 gr.
Extract of stramonium	2 grs.
Oil of anise	8 mins.
Nitrate of potassium	16 grs.
Rectified spirit	to $2\frac{1}{2}$ ozs.

The formula, which, it must be admitted, is somewhat complicated, was arrived at, we are told, by repeated experiments leading step by step to the addition of some effective remedy, and to the elimination of less effectual drugs.

Fuming inhalations which give off a good deal of smoke are used in the treatment of asthma and in sleeplessness. They usually take the form of nitre paper. Nitre papers are made from blotting-paper—the white is the best, as it is made from white rags. The paper is cut into squares of any convenient size—say six inches by six—and dipped into a hot saturated solution of nitrate of potassium, and allowed to dry either in the sun or in front of the fire. Their composition can be altered in various ways. For example, the solution may contain in addition to the nitre, chlorate of potash with or without iodide of potassium, and the papers when dry may be sprinkled over with Friar's balsam, or spirit of camphor, or tincture of sumbul. Some people recommend that a small piece of the paper should be burnt in a tumbler and the fumes inhaled; but a better plan is to set fire to a large piece of paper in the coal-scuttle, or on a fire-shovel, and fill the room with the smoke.

The inhalation of oxygen from a bag connected with a cylinder of compressed gas is useful in pneumonia,

phthisis, chronic bronchitis, and possibly in certain gouty conditions. Compressed air has been employed in the treatment of emphysema, and other gases are from time to time used in special cases.

These, then, are the principal channels and methods by which drugs may be introduced to the system. There are other methods, but they are of less importance, and are usually employed for the production of a local effect. Drops for the eye—atropine or homatropine—might produce a constitutional effect. Urethral injections are familiar to every one, and urethral bougies are in common use. Bougies of iodoform, belladonna, and sulphate of zinc are used in coryza, nasal polypus, and allied affections. Morphine suppositories are introduced into the vagina after labour, and perchloride of iron is sometimes injected into the uterus to arrest hæmorrhage; but these are not ordinary methods for the administration of medicines. Drugs are sometimes applied locally, in the form of gases or vapours. For example, a few drops of chloroform placed on the hand and held in front of the eye will give relief in cases of photophobia. Dr. George Stoker's treatment of ulcers by the local application of oxygen gas may be mentioned.

ACTIVE PRINCIPLES.

A great number of medicinal plants contain active principles. Some of them are alkaloids and some are not.

ALKALOIDS—the name is derived from *alkali* and εἶδος "a likeness"—are for the most part formed in the tissues of plants or animals. A few are prepared synthetically.

Alkaloids are analogues of ammonia. They are in reality ammonia in which one, or perhaps more, of the atoms of hydrogen is replaced by a radicle.

Alkaloids usually contain nitrogen, carbon, and hydrogen.

These are chemically amides. In a few alkaloids there is no oxygen. These are chemically amines.

Alkaloids are, as a rule, solid; but when they contain no oxygen they are oily liquids.

As examples of solid alkaloids we may mention morphine, quinine, atropine, strychnine, and apomorphine.

The principal liquid alkaloids are nicotine, coniine, pilocarpin, and jaborine.

Alkaloids, with the exception of codeine and brucine, are insoluble in water. They all dissolve in alcohol.

Alkaloids have an alkaline reaction, and readily combine with acids to form salts, which are readily soluble in water.

Most alkaloids have a powerful physiological action.

As regards nomenclature, the distinctive mark of an alkaloid is the termination "ine," for example, morphine and quinine.

Vegetable alkaloids are precipitated from solutions by certain reagents which are known as alkaloidal group reagents. These are:—

1. Wagner's reagent, prepared by dissolving iodine in a solution of iodide of potassium.

2. Sonnenshein's reagent, prepared by dissolving phosphomolybdate of sodium in ten times its weight of water and adding one-tenth of its volume of strong nitric acid.

3. Mayer's reagent, made by adding a solution of potassium iodide to a solution of mercuric chloride until the red precipitate, at first thrown down, is redissolved in the excess of potassium iodide.

4. Scheibler's reagent, which is phosphotungstic acid.

Some of the alkaloids are precipitated by all these reagents, others by one or more of them.

During the process of decomposition of animal matters alkaloids are formed which are known by the generic title

of "ptomaines." They closely resemble vegetable alkaloids —atropine, morphine, and codeine, for example—not only in chemical characters, but in physiological properties. They are commonly produced in animal substances exposed to the air, after having been for some time excluded from it. They are found in corpses which have been exhumed, and also in potted meats and tinned foods only partly consumed the day they are opened.

As far back as 1822 Gaspard and Hick extracted a toxic principle from corpses. In 1866 my colleague, Dr. Dupré, found an alkaloidal principle resembling, in many of its properties, quinine, in the liver. In 1868 Bergman and Schmiedeberg obtained from putrid beer the nitrogenous crystalline substance now known as sepsine. Cretanine was discovered in urine by Liebig and Pettenkofer. Luff gives a list of the principal ptomaines which have been extracted from putrefying animal matters and submitted to ultimate analysis. From putrefying horseflesh and mackerel we get collodine ($C_8H_{11}N$), parroline ($C_9H_{13}N$), and hydrocollodine ($C_{10}H_{15}N$). From human corpses we get putresine ($C_4H_{12}N_2$), neuridine ($C_5H_{14}N_2$), cadaverine ($C_5H_{16}N_2$), neurine ($C_5H_{13}NO$), and choline ($C_5H_{15}NO$). Gaduine ($C_7H_{16}NO_2$) is obtained from putrid codfish, creatinine ($C_4H_7N_3O$) from urine, sarkine ($C_5H_4N_4O$) from urine and flesh, carnine ($C_7H_8N_4O_3$) from fresh meat, and guanine ($C_5H_5N_5O$) from guano. These are all active poisons, and it is not at all improbable that in a few years they will be used as therapeutic agents. Instead of prescribing calomel or compound rhubarb pill we shall give minute doses of cadaverine or sepsine.

The different ptomaines have given rise to many cases of poisoning, sometimes on a large scale. In suspected criminal poisoning, when an alkaloid is detected in the exhumed body, the common defence is that the symptoms

observed are due to cadaveric alkaloids and not to a vegetable poison. Dr. Stevenson was cross-examined on these lines in the celebrated Lamson case, tried in 1882.

The first alkaloid extracted was morphine. Its discovery is due to Friedrich Wilhelm Adam Sertürner, an apothecary of Eimbeck in Hanover. He had been engaged for eleven years in a study of the chemical composition of opium, and in 1816 he announced that a substance which he had discovered, in addition to possessing a well-marked alkaline reaction, was capable of uniting with acids to form salts. He even hazarded the conjecture that it was closely allied to ammonia. His observations attracted much attention, and many of the better-known toxic and medicinal plants were submitted to chemical analysis, the result being the discovery, within sixteen years of the appearance of Sertürner's work, of strychnine, brucine, quinine and cinchonine by Pelletier and his associate Caventon, of narcotine and codeine by Robiquet, of veratrine by Meissner, of coniine by Giesecke, of atropine by Mein, of nicotine by Reimann and Posselt, and of aconitine and hyoscyamine by Geiger and Hesse.

It is by no means an easy matter to extract an alkaloid from a plant, and it is not particularly easy to recognize it when it is obtained. If it is an alkaloid or alkaloidal salt it will, when heated to redness, completely burn away. When mixed with caustic soda and lime and heated it will evolve the odour of ammonia. A solution of one of its soluble salts will give a precipitate with tannic acid, picric acid, chloride of gold, iodide of potassium and mercury, and with various other substances which are known to precipitate alkaloids. Apart from its chemical reactions, its physiological properties may throw some light on the subject. Care must be taken not to mistake a salt of ammonium for a salt of an alkaloid.

It is well known that several so-called alkaloids are, in

reality, mixtures of other alkaloids. For example, daturine is a mixture of atropine and hyoscyamine. Then, again, an alkaloid which has been obtained from different sources, and investigated by different observers, may be known by two or more different names. For example, duboisine is identical with hyoscyamine; and pituri, the alkaloid of *Duboisia Hopwoodii*, is identical with nicotine.

Many plants contain more than one alkaloid. It often happens that the second alkaloid has practically the same physiological action as the first, but is weaker—morphine, and codeine, and strychnine, and brucine, for example.

Sometimes the two alkaloids contained in a plant are antagonistic in action. For example, physostigma contains physostigmine or eserine and calabarine. Physostigmine paralyzes the spinal cord, whilst calabarine acts like strychnine and stimulates it. In the same way, jaborandi contains two alkaloids, pilocarpine which produces sweating and salivation, and jaborine which acts like atropine and checks sweating and dries the mouth. In some cases there are two pairs of alkaloids, a stronger and a weaker having one action, and another pair, one strong and the other weak, antagonistic in action to the first pair. Some alkaloids curiously enough always run in couples; for example, strychnine and brucine are always found together.

That one alkaloid can be made from another is well known. Morphine and apomorphine are a case in point.

It is well known, too, that by altering the chemical constitution of an alkaloid its physiological action can be completely changed. This subject is discussed in detail in the section on physiological action.

The following is a list of the twelve most popular alkaloids:—

1. *Morphine.*—The chief alkaloid of opium, employed in

the form of the acetate and hydrochlorate to induce sleep and relieve pain.

2. *Quinine.*—Used in the form of sulphate as a tonic, to relieve the pain of neuralgia, and in large dose as an antipyretic.

3. *Atropine.*—The alkaloid of belladonna and some allied plants, used in the form of sulphate to dilate the pupil and check secretions.

4. *Strychnine.*—The chief alkaloid of nux vomica, always found in combination with brucine, a nervine tonic, and in toxic doses a tetaniser.

5. *Pilocarpine.*—The chief alkaloid of jaborandi, largely used to induce perspiration and salivation.

6. *Aconitine.*—The active principle of aconite, used externally as an ointment and internally in doses of one two-hundred-and-a-fortieth of a grain for neuralgia.

7. *Apomorphine.*—A derivative of morphine, given hypodermically as an emetic and by mouth as an expectorant.

8. *Codeine.*—The second most important alkaloid of opium, allied to morphine, but weaker, and given in doses of from half to two grains.

9. *Physostigmine.*—Also known as eserine, the most important alkaloid of physostigma, contracts the pupil, and in large doses paralyzes the lower extremities.

10. *Caffeine.*—The active principle of coffee, used in form of citrate as a diuretic, and to cure headache.

11. *Cocaine.*—The active principle of coca; used for dilating the pupil, and as a local anæsthetic when applied to mucous membranes.

12. *[illegible]*—The alkaloid of henbane, allied in [illegible] action to atropine, and used for much the [illegible]

[illegible] is not a true alkaloid, but is a mixture of

atropine and hyoscyamine. Duboisine, the active principle of duboisia myoporoides, is identical with hyoscyamine and isomeric with atropine.

The following alkaloids, although interesting from a physiological point of view, are less frequently employed as therapeutical agents:—

Thebaine.—An alkaloid obtained from opium, acts as a tetaniser, and is allied in action to strychnine and brucine.

Brucine.—An alkaloid obtained from nux vomica, has a similar action to strychnine, but in a minor degree.

Apocodeine.—An alkaloid obtained from morphine or codeine, having similar actions to apomorphine, but less pronounced.

Cinchonine.—An alkaloid obtained from cinchona, employed in the form of sulphate, has much the same properties as quinine, but is cheaper.

Homatropine.—A derivative of atropine, dilates the pupils and checks the secretions.

Gelsemine.—The active principle of gelsemium, used in the treatment of neuralgia, especially of the fifth nerve.

Jaborine.—A minor alkaloid obtained from jaborandi, antagonistic to pilocarpine and allied to atropine.

Colchicine.—The alkaloid of colchicum, used in the treatment of gout.

Veratrine.—An alkaloid or mixture of alkaloids obtained from the asagræa officinalis, actively poisonous, and not often used, except in form of ointment for neuralgia and rheumatism.

Muscarine.—The active principle of poisonous mushrooms, used in physiological experiments to arrest the frog's heart.

Curarine.—The alkaloid of curare, used to paralyze the motor nerves in tetanus and hydrophobia.

Coniine.—The active principle of conium, a volatile liquid alkaloid.

Nicotine.—A liquid alkaloid obtained from tobacco, exhibits in a marked degree toxic properties.

Hydrastine.—An alkaloid obtained from hydrastis, used as a hepatic stimulant.

Emetine.—An alkaloid obtained from ipecacuanha.

Hygrine.—A second alkaloid obtained from coca.

Calabarine.—The minor alkaloid of calabar bean, is a tetaniser like strychnine, and is antagonistic to physostigmine.

Erythrophlœine.—An alkaloid obtained from casca or sassy bark. It has a digitalis action, and produces convulsions like those of picrotoxin.

Sparteine.—A volatile alkaloid obtained from broom tops. Its action is identical with that of coniine, and it paralyzes the ends of the motor nerves and the vagi.

Glucosides or Neutral Principles resemble alkaloids in having a powerful physiological action, and in representing the activity of the plants from which they are derived.

The characteristic of a glucoside is that, when heated with a dilute mineral acid and water, it yields glucose as one of the products of decomposition. The other product, formed at the same time, differs in character from the original glucoside. Thus salicin, when boiled with dilute sulphuric acid, splits up into dextro-glucose and a body known as saligenin.

As regards nomenclature, it may be noted that the names of neutral principles end in "in," and not in "ine," as in the case of alkaloids.

We have examples of neutral principles in aloin, salicin, santonin, and picrotoxin.

Four of the active principles contained in digitalis are [illegible]—digitalin, digitaleïn, digitonin, and digitin.

The following is a list of neutral principles which are not alkaloids:—

Picrotoxin.—An active principle obtained from cocculus indicus, produces epileptiform convulsions by action on medulla, and in doses of one-sixtieth of a grain checks the night sweating of phthisis.

Salicin.—A crystalline glucoside obtained from various species of salix, allied in action to salicylic acid, and used in the treatment of rheumatism.

Santonin.—A crystalline neutral principle obtained from santonica, produces yellow vision, and colours the urine bright yellow, used for the expulsion of round worms.

Elaterin.—The active principle of elaterium, a powerful hydragogue purgative.

Saponin.—A glucoside obtained from quillaia or soap bark, induces sneezing, and arrests the heart in diastole.

Digitoxin, Digitaleïn, Digitalin.—Active principles derived from digitalis, in small doses stimulate the action of the heart, and in large doses arrest it in diastole.

Digitonin.—Also obtained from digitalis, allied in action to saponin, and antagonistic to digitoxin, digitaleïn, and digitalin.

Strophanthin.—The active principle of strophanthus hispidus. It has a digitalis action, and is one of the most active poisons with which we are acquainted. It is three hundred times as strong as Merck's digitalin.

Adonidin.—The active principle of adonis vernalis, belongs to the digitalis group. It is about ten times as active as digitoxin.

Convallamarin.—Is a glucoside obtained from convallaria, the lily of the valley, and it has a digitalis action.

Convallarin.—Is another glucoside obtained from convallaria. It has no action on the heart, and is a purgative.

Aloïn.—A crystalline principle obtained from aloes.

It has the characteristic bitter taste of the drug, and when given internally in doses of two grains acts as a purgative.

Cannabin.—A resinoid substance representing the activity of cannabis sativa.

Jalapin.—The chief constituent of the resin of scammony.

Convolvulin.—The chief constituent of the resin of jalap.

Ergotin is not an active principle, but is a purified extract of ergot. Chrysarobin is a mixture containing chrysarobin, chrosophanic acid, and other substances.

In addition, we have a number of so-called active principles, which are in reality resinoids made by adding a concentrated fluid extract of the drug to a large quantity of water. To this group belong baptisin, cimicifugin, euonymin, gelsemin, hamamelin, helonin, hydrastin, phytolaccin, sanguinarin, and senecin.

THE STUDY OF MATERIA MEDICA.

Most students get up their Materia Medica by learning it straight out of a text-book. Treated in this way it is not by any means an inviting subject, and a student poring over a British Pharmacopœia is not a picture of contentment.

A far better plan is to discard the book and work at the specimens themselves. A description from actual observation is always more to the point than a formal definition.

Students who come up for examination often make use of long words without understanding very clearly what they mean. Such terms as "efflorescence," "deliquescence," and

"fluorescence," are scattered about in reckless profusion and without any particular regard for the consequences. A student on one occasion stated that bicarbonate of soda was "efflorescent," and on being asked to explain the word gave the botanical definition evidently without recognizing the fact that it was hardly appropriate.

The real way to study materia medica is to take a specimen and describe it in your own fashion.

1. **General Appearance.**—In the first place you note its appearance. It may be liquid, like bromine, or chloroform, or ether, or cod liver oil, or it may be solid. If it is solid it may be in masses, like bark, or it may be in crystals, like sulphate of potassium. The shape of the masses or crystals should be described. If it is a powder it may be amorphous, like carbonate of bismuth, or crystalline, like sulphate of quinine.

2. **Colour.**—Next its colour should be noted. It may be black, like charcoal, yellow, like sublimed sulphur, red, like the periodide of mercury, or grey, like grey powder.

3. **Weight.**—Then its weight should be noted. It may be heavy, like litharge or the salts of mercury, or it may be light, like magnesia or cotton wool.

4. **Odour.**—Next its odour is of importance. Smells are difficult to describe, but there are certain terms which are pretty generally recognized. Thus we say that bromine has a disagreeable acrid odour, ammonia has a pungent odour, alcohol a spirituous odour, sweet spirits of nitre a fruity odour, nitrite of amyl an odour like jargonelle pears, and so on. There are a good many drugs which can be readily recognized by the smell alone, ammonia, acetic acid, prussic acid, chloroform, ether, bromine, iodoform, carbolic acid, creasote, musk, sumbul, and a host of others.

5. **Taste.**—Then the taste has to be described. A substance may be sweet, like sugar or extract of malt, or it may

[redacted]

be acid, like hydrochloric acid or vinegar, or it may be alkaline, like carbonate of potassium, or bitter, like sulphate of quinine or colocynth, or acrid, like liquor potassæ, or saline, like common salt or saltpetre or sal-ammoniac, or pungent, like mustard or horseradish or capsicum or peppermint, or it may be astringent, like catechu or kino, or it may be aromatic, like cinnamon, or it may be styptic, like perchloride of iron, metallic, like perchloride of mercury, and so on. These are not nearly all the terms used in describing the different varieties of taste; there are a great many more. Sometimes combinations of terms are employed, thus, permanganate of potassium is said to have a taste which is "sweet, astringent, and somewhat mawkish."

6. **Affinity for Water.**—Next to taste comes affinity for water, and this, in many cases, is a matter of considerable importance. Some drugs take up water readily, and if exposed to the air for even a short time become "deliquescent." A good example of this is afforded by acetate of potassium. If exposed to the air it liquifies so that it is usually kept in tightly stoppered bottles. Other drugs are "efflorescent;" that is, they part with their water of crystallization and become white and powdery on the surface. This is seen in the case of carbonate of sodium and other salts.

7. **Effect of Heat.**—The effect of heat on the specimen is worth noting. Some drugs burn readily, as, for example, phosphorus, which unless kept in water is apt to catch fire spontaneously; and the hypophosphites of lime and sodium. Others are volatilized by heat, as, for example, iodine, which gives off violet fumes when exposed to sunlight. Others remain fixed and unaltered, like charcoal; and others, again, are fusible, like sulphur.

8. **Chemical Tests.**—In many cases it is desirable to test

the drug with reagents. Tests would be applied in the case of a salt first for the base and then for the acid.

PHARMACOLOGICAL INVESTIGATION.

An attempt will be made in this section to give some kind of a rough idea of the general lines followed by the pharmacologist in investigating the action of an unknown drug.

There are two methods—the clinical and the physiological—by which the actions of medicinal and other agents can be investigated. By the clinical method observations are made on men and animals in a state of disease with a view to cure the diseased condition, whereas by the physiological method experiments are made on healthy animals with the view of determining the action of the modifying agent on a body not rendered abnormal by the incidence of disease. The clinical method is as old as medicine itself, but physiological investigation is of comparatively recent date and has become necessary from the limitations of clinical observations. Every experiment with a drug on a healthy organism is merely auxiliary to its employment in the cure of disease and for the alleviation of suffering.

As a rule the uninvestigated crude drug is sent to England by some traveller or explorer, or possibly by a doctor practising in some tropical district. The consignment is usually accompanied by a statement or memorandum giving the native name or names of the drug and a brief description of the mode in which it is employed. It may be stated, for example, that the drug is prepared by the priests or by the chiefs of the tribe, and used as an arrow-poison; or there may be a statement to the effect that it

is employed as an ordeal poison for the detection of crime; or possibly we may be told that the leaves are made into a tea, and that when administered in cases of snake-bite or fever it produces profuse perspiration or perspiration and salivation. Sometimes the rough effect of the drug on animals has been noted, and we are told that when birds eat the berries they drop down dead, whilst cattle grazing in the fields where the plant grows become paralyzed. Sometimes attention is directed to a drug by cases of poisoning. For example, a consignment of beans is brought from Africa, and there being no known use for them they are cast on the quay, where they attract the attention of a crowd of schoolboys, who eat them and are taken to a hospital, where certain symptoms are noticed and recorded for publication. Sometimes something more specific is asserted, and we are told that the drug is a positive remedy for consumption or cancer. These are examples of the kind of history we get with samples of new drugs.

The first step is to endeavour to ascertain the botanical origin of the plant. Even if the genus and species cannot be determined the natural order will present no difficulty, and may afford a useful clue. For example, if the drug belongs to the atropaceæ or to the logoniaceæ we know pretty well what to expect.

The next step is to make the plant into a tincture or fluid extract. We first make a preparation of the whole drug, and then of the leaves and root separately. The pharmacologist then tries it on himself, commencing with a very small dose and day by day increasing it until some definite symptom is noticed. The symptoms are carefully recorded, and if they are severe the pharmacologist or his fellow workers will have an opportunity of trying various antidotes. Should the drug kill the pharmacologist the post-mortem appearances will be noted. If no action results

from a large dose the drug is presumably inert, and the investigation comes to an end.

In the event of the symptoms indicating an active drug an attempt will be made to extract an alkaloid or active principle. Probably the alkaloid will yield salts soluble in water, and this solution in various strengths is used in subsequent investigations.

The pharmacologist drops some of the solution into his eye and notes the effect on the pupil. It may dilate it or it may contract it, or it may produce anæsthesia or intense inflammation.

When the investigator has recovered from the effects of this observation he proceeds to inject himself hypodermically with various doses of the alkaloid, again noting the symptoms.

After this he feels justified in giving a frog a small injection hypodermically, with the view of ascertaining the general effect on the animal.

Subsequently he piths a frog, and after opening the pericardium, applies a few drops of the solution to the heart, noting whether it produces any irregularity in the ventricular contraction and, if the heart ceases to beat, whether it is arrested in systole or in diastole. The effect of other drugs in restoring its action is observed, and the influence of the drug in antagonizing the effect of muscarine on the heart is investigated.

These preliminary experiments will throw some light on the general action of the drug, and a good idea will be formed as to the class of remedies to which it belongs and as to the system on which it primarily acts. After this the investigation will branch off in various directions, according to the indications obtained. It need hardly be said that even the simplest experiments of this kind cannot be carried out by unskilled observers. It requires experience, it takes

up a great deal of time, it involves a considerable expenditure of money, and the only reward is unlimited abuse.

The organs of cold-blooded vertebrates, especially the frog, are best adapted for pharmacological investigation, because they, equally with those of mammals, are susceptible to the action of poisons, and may be isolated from the rest of the body without impairment of function. For example, experiments may be made on the isolated heart of the frog or on nerve-muscle preparations. Again, by tying blood-vessels the action of the drug may be confined to one particular extremity, or, on the other hand, that particular limb may alone be exempt from the action of the poison. There are certain peculiarities in frogs which have to be carefully studied. There are various species, and at different seasons of the year different effects may be induced.

Observations on ciliary motion are amongst the simplest with which we have to deal. A frog after being pithed is placed on its back and the lower jaw removed, so as to render readily accessible the mucous membrane covering the palate and the upper part of the pharynx, parts which are abundantly covered with ciliated epithelium. A fragment of sealing-wax not bigger than a pin's head is attached to an ultimate fibre of silk and suspended in such a manner that it only just comes in contact with the ciliated mucous membrane, the greater part of its weight being supported by the thread. The cilia acting on the sealing-wax cause it to move gradually downwards towards the lower part of the pharynx. Two pins are then fixed in the mucous membrane about an inch apart, and the time taken by the float to traverse the distance between them is noted by a metronome beating seconds. Undue evaporation is prevented by surrounding the animal with moist blotting-paper, and the mucous membrane itself is wetted at fixed intervals with a definite quantity of normal saline. When the average

time taken to run the course has been determined with sufficient accuracy, the drug dissolved in the saline solution is applied and the effects are noted. In an observation with pilocarpine the normal duration of the transit was found to be 64 seconds. The average of observations taken every five minutes during the first quarter of an hour after the application of the drug was 79 seconds, in the next quarter 104 seconds, and in the next 180 seconds. On washing away the drug with normal saline the rate improved in twenty-five minutes from 600 to 155 seconds. This is a very simple form of experimentation, but is useful for class demonstration when no apparatus is available.

The action of drugs on the voluntary muscles of cold-blooded animals can be investigated in various ways. It is not, as a rule, a good plan to apply the drug directly to the muscle substance or to immerse the muscle in a solution of the drug, for nearly all solvents, even "normal saline," exert some influence on the muscle structure. If, however, the drug is a gas, or can be obtained in the form of a vapour, the mode of procedure is simple, and it is easy enough to improvise an apparatus. A wide-mouth bottle is furnished with a tightly fitting cork perforated so as to admit two glass tubes, one of which for pumping in the gas dips under a layer of water at the bottom of the bottle, the other for the escape of the gas being shorter. A fine wire passing through the cork supports one end of the muscle by the tendon or bone and serves as one electrode, whilst a fine spiral wire attached to the other extremity of the muscle, and also passing through the cork, serves as the other electrode. As the gas acts only on the superficial fibres of the muscle, a long thin muscle, such as the sartorius of the frog, is selected. The object of passing the gas through the water at the bottom of the bottle is to keep the air moist and prevent the muscle from drying. In the majority

of cases, however, this method is not available, and the drug is administered to the frog hypodermically. When the poison has had sufficient time to act, the animal is pithed and the muscle with its motor nerve is excised for investigation. The results will of course have to be checked by an investigation of the condition of an unpoisoned muscle taken from the same animal. This presents no difficulty, for when the gastrocnemius with the sciatic nerve is selected the corresponding structures of the opposite limb can be protected, prior to the administration of the poison, by ligature of the common iliac or the femoral artery on that side. There is, however, a fallacy to be guarded against in this experiment, for some substances, the potash salts for example, are capable of becoming diffused through tissues shut off from the circulation almost as rapidly as when the blood supply has not been interfered with. When ligature of the femoral artery produces no modification in the condition of the muscle as compared with the poisoned muscle on the other side, the tissues which are supposed to be protected must be tested for the presence of the drug to make sure that there has been no diffusion.

The action of drugs on the motor nerve is of importance only with regard to their power of transmitting motor impulses to the muscles in which they terminate, and the same methods of investigation are employed as in the latter case.

To determine the local sensory action of a drug the method introduced by Dr. Thos. J. Mays of Philadelphia may be adopted. Five or six drops of a one or two per cent. solution of the drug should be dropped, either from a dropper or from a hypodermic syringe, into one nostril of a frog at intervals of from three to five minutes, the nasal reflex being tested by introducing the end of a very fine wire into the nostril under the influence of the drug, and

also into the nostril on the opposite side. As soon as the wire comes in contact with the inner surface of the untreated nostril the frog will make an effort to brush away the irritant with the front foot, whilst after the instillation of a drug having anæsthetic properties the reflex action on that side is abolished. In this way it has been shown the brucine, curarine, hydrastine, and many other drugs, possess local anæsthetic properties.

The action of drugs on the frog's heart may be determined by observations on that organ *in situ*, the pericardium having been previously slit open. The movements may be recorded graphically by means of the Frog Heart Lever, a simple rod of light wood balanced on knife edges set in steel supports. Observations may also be made on the extirpated heart, and if care is taken in cutting through the cardiac vessels, not to injure the sinus venosus, the heart will continue beating in a watch-glass containing normal saline solution for many hours. For supplying an artificial circulating fluid to the interior of a frog's heart a Kronecker's perfusion cannula may be employed, and this, if adapted to a Roy's tonometer, will record changes in the volume of the ventricle or auricles. The "circulating fluid" is made as follows:— Take 99 cc. of 0·6 per cent. chloride of sodium solution, saturate it with phosphate of lime, and add 1 cc. of a 1 per cent. solution of chloride of potassium.

Satisfactory results, both as to the rapidity of the heart's pulsations and its relation to various conditions of the vascular system, may be obtained in warm-blooded animals by the Marey or Pond sphymograph applied over an artery, by the cardiograph over the cardiac impulse, or by the Ludwig or Fick manometer, connected with an artery and registering the oscillations of the blood pressure. The best form of cardiograph is that of Marey and Chauveau as modified by Burdon-Sanderson.

The action of drugs and other agents on different organs may be investigated by means of the oncometer and other similar instruments. We take Roy's renal oncometer as an example. The kidney is enclosed in a metal box filled with warm oil, the box being so constructed that no oil can leak out, whilst the structures at the hilus of the organ are not injuriously pressed on, the vessels ureter and nerves being carefully protected. This is effected by the oncometer being made of two precisely similar parts, each half having a piece of peritoneum applied to it in such a manner that the space between the membrane and the wall of the oncometer can be filled with oil. The membrane being flexible, applies itself accurately to the kidney so that that organ is practically in the same position as the heart enclosed in the pericardium full of fluid. The heart corresponds to the kidney, and the visceral layer of the pericardium to the delicate membrane of the oncometer, the pericardial sac finding its equivalent in the oncomoter and the pericardial fluid in the oil filling the instrument. If the oil in the oncometer is placed in communication with a recording apparatus, we have an oncograph by which any expansion of the kidney can be recorded in the usual manner. If we record simultaneously the general blood pressure, the expansion and contraction of the kidney, and the excretion of the urine, we have the means of determining the action of any drug or agent in a very complete manner.

There are many different kinds of oncometers, such, for example, as the heart-oncometer. The apparatus is readily modified so as to adapt it for observations on the spleen or on the intestines, or on the foot of a dog, cat or rabbit.

The word oncometer (ὄγκος, volume) was introduced by Roy, and we speak of an arrangement of this kind with its recording apparatus as an oncograph. For estimating and [illegible] the amount of blood in a limb the apparatus

devised by Mosso, and known as the plethysmograph is commonly employed.

In making observations on the influence of drugs in promoting or retarding the secretion of the bile, Rutherford's method is usually adopted. Through an opening in the linea alba a glass cannula is inserted into the common bile duct, near its junction with the duodenum. To the end of the cannula, which projects from the abdomen, a short indiarubber tube is attached, terminating in another glass tube having a narrow aperture through which the bile can exude in drops. The gall-bladder is compressed in order to fill the tube with bile, and the cystic duct is then clamped to prevent its return to the gall-bladder, and compel all the bile secreted to flow through the cannula. The bile is collected in a fine cubic centimeter measure, the quantity being read off every quarter of an hour. The drug, the action of which is being investigated, is injected by means of a small syringe into the duodenum from which it is rapidly absorbed. This is a great improvement on Röhrig's method of working with permanent fistulæ and collecting the bile either in a bag attached to the cannula, or by means of a sponge placed in a tin box secured to the abdomen.

It does not fall within the scope of this book to describe all forms of apparatus employed in pharmacological investigation. For further details the student is referred to the third edition of "Stirling's Practical Physiology," and to Stewart's excellent "Manual of Physiology" (1895). The latter contains a series of practical exercises which will be found of much value to the pharmacologist.

PHYSIOLOGICAL ACTION.

It is difficult to lay down rules for describing the physiological action of a drug; but by taking the different

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structures and organs of the body systematically, it is not likely that anything of importance will be omitted.

A practical acquaintance with the effects produced by various drugs is of importance, not only to the therapeutist, but to the specialist in Forensic Medicine. A poison may be present in such small quantities that it cannot be detected by chemical tests, although its physiological actions may amply suffice to determine its nature. In more than one instance physiological tests have been the main instruments in securing a conviction for murder. We may take as an example the case of Dr. de la Pommerais, who, in Paris in 1864, insured the life of a woman named Pauw, for £22,000, and then gave her digitalin, the active principle of digitalis, from the effects of which she died. No poison was detected in the body by chemical analysis, but it was shown in evidence that shortly before her death the deceased had vomited on the floor. A spirituous extract was made of the scrapings of the wood, and of the substance deposited between the planks. A few grains of this extract were injected into a dog, which soon suffered from vomiting and depression of the heart's action, and died in twenty-two hours. Similar effects were produced in a rabbit, and on this evidence the prisoner was convicted and executed.

In the celebrated Lamson case, tried in 1882, physiological experiments were made with an extract prepared from the contents of the stomach of the deceased, and when given hypodermically to mice the symptoms observed were found to be identical with those following the administration of aconitine, and on this evidence mainly a conviction was secured.

Some drugs produce a very definite effect when applied to the skin. Mustard, for example, gives rise to redness and burning, cantharides blisters, whilst the vapour of chloroform or ammonia, when confined, acts as a powerful

irritant. Other drugs act on the mucous membrane, as, for example, aconite, which produces numbness and tingling in the mouth, throat, and adjacent parts.

Some drugs when inhaled in the form of fine powder produce persistent sneezing, and we have examples of sternutatories, or errhines, as they are called, in casca bark, in powdered quillaia bark and saponin, in ipecacuanha and colocynth, and in veratrine.

Some drugs act on the blood, or on some one of its constituents; iron, for example, and the group of the nitrites.

Some drugs act on the blood-vessels, altering in some way their calibre; nitrite of amyl, nitroglycerine, and ergot, for example.

Then there are drugs which act upon different parts of the nervous system. Opium acts on the brain, picrotoxin on the medulla, strychnine and physostigmine on the cord, coniine and curare on the motor nerves, and aconitine and cocaine on the sensory nerves.

The following drugs act on the cord and produce tetanus:—

Nux vomica, strychnine, brucine.

Thebaine.

Belladonna, hyoscyamus, stramonium.

Atropine, homatropine, hyoscyamine.

Calabarine.

The belladonna group produces what is called "late tetanus," tetanus, that is, which comes on as the primary paralysis is passing off.

The chief depressants or paralyzers of the cord are:—

Physostigma—physostigmine or eserine.

Chloral hydrate—paraldehyde.

Bromide of potassium, bromide of sodium, bromide of ammonium, and bromide of strontium.

Other drugs act on the muscles, either on the voluntary or involuntary muscular system, and as examples ergot, nux vomica, veratrine, and phosphorus may be mentioned. The action of ergot in parturition, in arresting post-partum hæmorrhage and other forms of bleeding, is the result of its power of stimulating muscular tissue. The benefit derived from belladonna in incontinence of urine, and from belladonna and nux vomica in the treatment of habitual constipation, is another example of this power. The influence of veratrine on the muscle curve is a common class demonstration, whilst the action of phosphorus and the salts of vanadium in inducing fatty degeneration of muscular tissue is well known.

Certain drugs taken into the stomach act as emetics. Some act topically or locally, whilst others are absorbed into the circulation and affect the vomiting centre. Mustard, alum, and salt are examples of local emetics, whilst apomorphine is the best representative of the second division. Some drugs, such as sulphate of zinc and tartar emetic, probably act both as general and local emetics.

Many drugs act as sedatives to the mucous membrane of the stomach, and this group includes the salts of bismuth, dilute hydrocyanic acid, oxalate of cerium, and creasote.

Of stomachic stimulants or carminatives we have examples in oil of cajeput, pure terebene, pinol, eucalyptol, and capsicum.

The stomachic tonics or bitters are gentian, cabumba, quassia, chiretta, cusparia, and also strychnine and quinine.

Pepsin and other ferments are digestive agents which [illegible] to disintegrate the food and render it ready for [illegible] when there is a deficiency of natural gastric [illegible]

[illegible] affect the bile-secreting or bile-expelling [illegible] [illegible]phyllin resin is a hepatic as well as an

intestinal stimulant. Both enonymin and iridin powerfully stimulate the liver, whilst they exert but very little action on the intestine. Sulphate of sodium is a hepatic stimulant, whilst sulphate of magnesium exerts no such action, a point of considerable importance in the selection of a natural purgative water. Hunyadi Janos water contains 122 grains of sulphate of sodium in 16 ozs. troy, Friedrichshall water $46\frac{1}{2}$ grains, and Carlsbad (Sprudel) only 19·9 grains.

Opium and morphine, although commonly employed to check diarrhœa, exert their influence on the intestinal movements and secretions only, and, contrary to the generally accepted opinion, do not affect the biliary secretion. Acetate of lead, especially in large doses, is a direct hepatic depressant, and is probably the only drug which possesses this effect without producing purgation. Drugs which exert a purgative effect by their action on the intestines, not infrequently check the secretion of the bile. Clinical observation in these cases is often fallacious, and we have to rely almost entirely on carefully conducted pharmacological experiments.

Many drugs exert an influence on the kidneys, and either directly or indirectly alter the quantity, appearance, and composition of the urine. Some drugs increase the amount of water, urea, or uric acid secreted, whilst others diminish them. Diuretics produce their effects in various ways, such as by acting on the circulation and raising the pressure in the glomeruli, or by acting directly on the secreting cells of the tubules.

Some drugs, such as the carbonates and bicarbonates of potassium, sodium, and lithium, render the urine alkaline, whilst benzoic acid and the compound tincture of benzoin, from the facility with which they yield hippuric acid, are useful in keeping up the acid reaction.

Many drugs alter the colour of the urine. For example,

carbolic acid, salicylic acid, and resorcin turn it black or nearly so, rhubarb stains it yellow, santonin produces a yellow colour if the urine is acid, and a blood-red if alkaline.

Phosphorus, turpentine, and pure terebene impart an odour of violets to the urine, whilst the effect of asparagus in this relation is well known. Some drugs, such as cantharides and turpentine, produce hæmaturia and albuminuria, whilst after the inhalation of nitrite of amyl, ether, or chloroform, glycosuria is not infrequently observed.

A few drugs exert an action on the bladder without affecting the kidneys, except perhaps indirectly. Pilocarpine causes contraction of the muscular wall of the bladder, and many drugs may be classed as vesical sedatives or vesical alteratives. Cubebs, copaiba, and oil of sandal wood are valued for their action on the mucous membrane of the urethra.

Some drugs appear to exert an action on the sexual organism. For example, strychnine, phosphorus, cantharides, and damiana are said to be aphrodisiacs, whilst the bromides are undoubtedly anaphrodisiacs. Some drugs, such as permanganate of potassium, binoxide of manganese, and senecio, have a distinct emmenagogue action, whilst ergot savin, rue, pennyroyal, and powdered bitter apple, are supposed to be ecbolics, and are popularly employed as abortifacients.

Many drugs exert a special action on the eye, which may be by altering the size of the pupil, by interfering with the power of accommodation, by increasing or diminishing intraocular pressure, or by stimulating the sensitiveness of the retina. Drugs which dilate the pupil are known as mydriatics, whilst those which contract the pupil are called myotics. The following is of list of drugs which act on the pupil:—

Pupil Dilators.	Pupil Contractors.
Belladonna.	Physostigma.
Hyoscyamus.	Physostigmine.
Stramonium.	Jaborandi.
Atropine.	Pilocarpine.
Homatropine.	Muscarine.
Hyoscyamine.	Nicotine.
Duboisine.	Opium.
Piturine.	
Cocaine.	

General anæsthetics contract the pupil during the early stage, but may subsequently dilate them.

Gelsemium produces ptosis and double vision.

Cocaine is used for its local anæsthetic properties on the conjunctiva and deeper structures.

Many drugs in the process of elimination by the skin produce certain effects.

The secretion of the sweat is increased by jaborandi, pilocarpine and pilocarpidine, by muscarine, physostigmine, and picrotoxin, and to a slighter degree by antimony, Dover's powder, and the acetate of ammonium. Some drugs, such as jaborandi and pilocarpine, which produce sweating, also promote the growth of the hair, and are employed for this purpose.

The drugs which dry the skin by arresting secretion are belladonna, atropine and homatropine, hyoscyamus and hyoscyamine, stramonium and the two secondary or antagonistic alkaloids of jaborandi, jaborine and jaboridine. Oxide of zinc, tannin, and some other astringents exert a somewhat similar effect although they fall within a different category.

It will be seen that, as a rule, drugs which contract the pupils are sudorifics or diaphoretics, whilst the pupil

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dilators are anhydrotics. There is practically no difference between a diaphoretic and a sudorific, but the term diaphoretic is used when the secretion is only slightly increased and evaporates as fast as it is formed, whilst a sudorific is something which increases the sweat in such quantities that it pours off the skin in drops. It is a distinction of no practical importance.

Many drugs are eliminated wholly or in part by the skin, and in the process of elimination produce rashes of various kinds.

The following are some drugs which produce a rash :—

Bromide of potassium Bromide of sodium Bromide of ammonium Bromide of strontium	Acne, chiefly on the face and back.
Iodide of potassium Iodide of sodium Iodide of ammonium Iodide of strontium Syrup of iodide of iron	Acne, and less commonly petechiæ, all over the body.
Tar	Acne
Belladonna ... ... Hyoscyamus ... ... Stramonium ... ... Atropine ... ... Hyoscyamine ... ... Homatropine	An erythema, like the rash of scarlet fever.
Chloral hydrate ...	Erythema.
Antipyrin	Erythema, chiefly on thighs and abdomen, attended with much itching.
Copaiba	Urticaria, or a rash like measels.
Cubebs	Urticaria.

Salicylic acid	Urticaria.
Arsenic	Eczema.
Mercury	Eczema.

Morphine injected hypodermically sometimes produces a rash, and in exceptional cases a rash may follow the administration of quinine, guiacum, or hydrastis canadensis.

Antidiptheritic serum often produces a rash, accompanied by pains in the joints. The dried serum less frequently gives rise to a rash than the serum employed in the liquid form.

The long continued administration of nitrate of silver produces a permanent discoloration of the skin.

Croton oil, antimony, and sulphur produce a rash when applied externally.

The eruption produced by the inunction of antimonial ointment resembles that of small-pox. At first there is simple redness accompanied by burning pain. This is followed by the appearance of a number of small papules which soon become converted into vesicles and then into pustules, irregular in shape and size and varying from an eighth of an inch to an inch and a half in diameter. In cases of poisoning by tartar emetic, a rash of this description sometimes appears all over the body.

The eruption produced by the local application of croton oil to the skin is at first papular, but the spots soon assume the form of pustules, some of which are rounded and some flattened and umbilicated with a red areola.

Sulphur applied locally produces red rough erythematous patches, which may ultimately assume the form of eczema.

Some drugs produce itching of the skin, and the puritus of opium is well known. In a case of poisoning by codeine, the irritation of the skin lasted for many days.

Students often experience great difficulty in remembering what preparations of a drug are official, but a very good guess can generally be made from a consideration of the physiological action. If, for example, a drug is valued for its action on the skin or subjacent tissues, there will, in all probability, be a liniment or ointment or plaster. If the drug is a throat remedy there will naturally be a gargle or lozenge, or some equivalent preparation. The physical characters and solubility of the drug will also afford some indication of the form in which it is likely to be prescribed.

There can be no doubt that a relationship exists between chemical constitution and physiological action, and the properties of an alkaloid with regard to its action on the body may be altered by modifying its chemical composition. For much of our information on the subject we are indebted to the researches of Prof. T. R. Fraser and Dr. A. Crum Brown. They prepared from strychnine the iodide of methyl-strychnium. The difference in the composition of these substances is slight, strychnine being represented by the formula $C_{21}H_{22}N_2O_2$, whilst the iodide of methyl-strychnium is $C_{21}H_{22}N_2O_2CH_3I$. The difference in the pharmacological action of these bodies is very great. In none of Fraser's experiments, not even in fatal cases, were symptoms of tetanus induced by the methyl derivates of strychnine. In fact a condition exactly the reverse of that produced by strychnine followed the administration of the compound. In place of violent spasmodic contractions and muscular rigidity there was a perfectly flaccid condition of the muscles. There is a striking resemblance between the action of the methyl derivatives of strychnine and that of curare. The special characteristic of curare poisoning is that it produces paralysis by an impairment or destruction of the function of the peripheral terminations of the motor nerves. Experiments show that methyl-strychnium derivates

produce paralysis and death by destroying the function of the motor nerve end organs, and that the mode of action is identical with that of curare. It is remarkable that by so simple a chemical process the physiological action of the drug should be so completely changed.

By the addition of iodide or sulphate of methyl the action of brucine can be changed. Brucine acts as a kind of mild strychnine and is a convulsant poison, producing death either by exhaustion or asphyxia. Its methyl derivatives never produce convulsions, and although they cause death by asphyxia, this asphyxia, in place of being the result of prolonged and continuous muscular action, due to abnormal nerve activity, is the result of muscular paralysis resulting from partial or complete absence of normal nerve activity.

Thebaine, one of the alkaloids of opium, is a tetaniser, although somewhat inferior in power to brucine. The chief physiological action of the methyl derivates of thebaine is an impairment and, finally, a destruction of the functions of the peripheral terminations of the motor nerves, an action as unlike as can be the effects produced by thebaine itself.

Experiments with codeine, another of the opium alkaloids, show that its action is completely altered when it is converted into methyl codeine.

Sulphate of methyl-morphium is a paralyzing agent, the paralysis being due to an effect on the motor nerves.

The physiological action of nicotine, atropine and coniine may be modified or altered in much the same way.

Another curious example of the change which occurs in physiological action is afforded by the conversion of morphine into apomorphine. Chemically the only difference is that morphine loses a molecule of water.

Morphine	$C_{17}H_{19}NO_3$
Water	H_2O
Apomorphine	$C_{17}H_{17}NO_2$

Morphine is a narcotic and relieves pain, whilst apomorphine has neither of these actions, but is a powerful emetic and expectorant.

When cocaine is heated in a watery solution a methyl group is removed and replaced by hydrogen. The benzol-ecgonin which is formed differs completely in physiological action from cocaine, and no longer paralyzes the sensory nerves.

The influence of chemical composition in the case of aniline and some of its derivatives is well marked. Aniline itself, $C_6H_5NH_2$, dangerously depresses the nervous system, lowers the temperature, and by its action on hæmoglobin produces cyanosis. By replacing one of the atoms of H by acetyl (C_2H_3O) we form acetanilide or antifebrin, a substance which, if not free from objection, at all events possesses useful antipyretic and analgesic properties. Its toxicity is much less than that of aniline, although not unfrequently it produces cyanosis and other disagreeable effects. If we replace one atom of H in acetanilide by the radical OC_2H_5, we get phenacetin, which possesses the antipyretic and analgesic effects of acetanilide with still less of the aniline action. None of these drugs are perfect, but perhaps by-and-by we may get hold of something which will relieve pain without producing untoward effects.

THE BRITISH PHARMACOPŒIA.

The British Pharmacopœia "is intended to afford to the members of the medical profession and those engaged in the preparation of medicines throughout the British Empire, one uniform standard and guide, whereby the nature and composition of substances to be used in medicines may be ascertained and determined."

In prescribing mixtures, for example, it would be inconvenient to use the crude drugs, so we use what are called

"preparations." This would be impossible if we had no standard as regards strength and composition of these various preparations, and practically what the Pharmacopœia does is to tell us what they contain. We can prescribe liquor strychninæ, or liquor morphinæ acetatis, or black draught, or sal volatile with confidence, because we know that they are of uniform strength, and are not liable to vary according to the idiosyncrasy of the chemist. It is very much like buying a certain brand of tobacco, it is the same wherever you get it.

Medicines and their preparations described in the Pharmacopœia, are said to be "official," all others being "unofficial." Official preparations are sometimes called "galenical," *i.e.* pertaining to Galen. The term "officinal," is also in common use, but it is not identical with "official." Officinal preparations are such as are ordinarily kept ready prepared by the pharmacist.

Although the British Pharmacopœia is issued under the direction of the Medical Council, no medical man is restricted to the use of official drugs. He would no more hesitate to prescribe a drug because it was not in the Pharmacopœia, than he would refuse to visit a patient because his name did not happen to be in the Blue Book or Court Guide.

There are a good many other Pharmacopœias besides the British. The Pharmacopœia of the United States, for example, is highly esteemed; whilst the French Pharmacopœia or Codex contains many valuable preparations.

The following is a list of the chief national official Pharmacopœias—

NATION.	TITLE.
Great Britain and Ireland	British Pharmacopœia
United States	Pharmacopœia of the United States of America

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NATION.	TITLE.
France	Codex Medicamentarius Pharmacopée Française
Germany	Pharmacopœa Germanica
Austria	Pharmacopœa Austriaca
Russia	Pharmacopœa Rossica
Sweden	Pharmacopœa Suecica
Norway	Pharmacopœa Norvegica
Denmark	Pharmacopœa Danica
Spain	Farmacopea Española
Switzerland	Pharmacopœa Helvetica
Mexico	Nueva Farmacopea Mexicana

There are some half a dozen more, but this list sufficiently indicates the general run of their titles.

Almost every hospital, general and special, has its own particular pharmacopœia or collection of mixtures, pills, ointments, etc., and these are useful in facilitating rapid dispensing. Some are excellent compilations, whilst others are monuments of stupidity. At some hospitals the pharmacopœia would seem to have been authorized in the interests of the toxicologist or pathologist.

THE PRINCIPLES OF DOSAGE.

It is clear that as drugs differ much in their activity, some medicines must be given in smaller doses than others. No one requiring a purgative would think of taking the same dose of calomel as he would of Epsom salts. Many drugs, which in small doses act beneficially, would in large doses prove poisonous. There is no real difference between a medicine and a poison, for a drug, which in a large dose is an active poison, nearly always acts beneficially in small doses.

When we speak of the dose of a medicine, we mean that quantity which will produce the physiological action of the drug, either at once or after a series of repetitions. By the maximum or minimum dose we mean the quantity, as regards the limit of range which it is safe to give an average adult. We hear a good deal about "official doses," and a good many people seem to be under the impression that the "British Pharmacopœia" is to be accepted as the standard of dosage, and that the editor of that publication has the right to dictate to medical men in what quantities they are to prescribe their medicines. There is no foundation for this belief, a fact which is easily settled by reference to the "Pharmacopœia" itself. In the preface to that work it is stated that the doses given "are not authoritatively enjoined by the council, and the practitioner must rely on his own judgment, and act on his own responsibility in graduating the dose of any therapeutic agents which he may wish to administer to his patients." Most medical men depart widely, as occasion arises, from the doses given in the "Pharmacopœia." No one, for example, would care to accept ten grains as the maximum dose for sulphate of quinine, nor should we feel inclined to limit ourselves to twenty grains as the maximum dose of iodide of potassium, whilst, on the other hand, most of us regard fifteen minims as an extremely large dose for tincture of aconite, and hesitate—considering the uncertainty of the preparation of the article met with in commerce—to prescribe dilute hydrocyanic acid in eight minim doses.

It is important to remember the doses of those drugs which are given in only small quantities. The dose of sulphate of atropine is $\frac{1}{120}$ gr., of nitroglycerine from $\frac{1}{200}$ to $\frac{1}{100}$, and of aconitine about $\frac{1}{240}$ gr.

It must always be borne in mind that children require smaller doses of medicine than adults, and moreover that

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children are especially susceptible to the action of some drugs. Opium and all drugs of the narcotic class should be given with very great caution to children; but, on the other hand, they take grey-powder and all preparations of mercury well. Belladonna, too, is well borne by children, and in cases of whooping-cough, and in incontinence of urine it is by no means uncommon to prescribe for a child four years old ten minims of tincture of belladonna every four hours. Pilocarpine, which so readily induces perspiration and salivation in adults, has very little effect on children.

It is difficult to lay down absolute rules for determining the relative doses to be given at different ages. As a rule, the dose should be increased from birth to the prime of life; it reaches the maximum about fifty, and then gradually declines as age advances. The following table will prove of assistance in determining the dose to be administered.

Taking the dose for an adult as unity,

A patient	under 1 year of age	would require from	$\frac{1}{15}$ to $\frac{1}{12}$ of this dose.
"	2 years	"	$\frac{1}{8}$
"	3 "	"	$\frac{1}{6}$
"	4 "	"	$\frac{1}{4}$
"	7 "	"	$\frac{1}{3}$
"	14 "	"	$\frac{1}{2}$
"	20 "	"	$\frac{2}{3}$
"	from 20 to 50	"	the full dose, or 1.

It is not worth while trying to remember these figures, for there is a very simple rule by which the proportion may be found with sufficient exactness for all practical purposes. For children under twelve the adult doses of most medicines must be administered in the proportion of the age to the age increased by twelve; or, in other words, divide the child's age by the same number, plus twelve, and the required proportion will be obtained. For example, what proportion of the full dose must be given to a child four years old?

Child's age	4
Add 12 to child's age ...	16—proportion $\frac{1}{4}$.

The adult dose of bromide of potassium is about sixteen grains, and consequently we should give a child four years old only a quarter of this, or four grains.

The most accurate method of determining the dose is to weigh the patient, and to give so much per pound, but in actual practice this is not convenient. The method, however, is always resorted to in pharmacological investigations. For example, the minimum-lethal dose of strophanthine is for frogs about 0·0005 grain, or $\frac{1}{20000}$ of a grain per 100 grains weight of frog, and for rabbits about 0·003 grain or $\frac{1}{333}$ grain per pound weight of rabbit.

Doses of preparations are not difficult to remember.

The dose of all infusions is from one to two ounces, with the exception of the infusion of digitalis, the dose of which is from two to four drachms.

The dose of all aquæ is from one to two ounces, with the exception of cherry laurel water (aqua lauro-cerasi), the dose of which is from half to two drachms.

The dose of all decoctions is from one to two ounces.

The dose of the tinctures is from half a drachm to a drachm, except in the case of the tinctures of aconite, belladonna, cannabis indica, cantharides, capsicum, colchicum, digitalis, iodine, lobelia, nux vomica, opium, squills, veratrum viridis, essence of ginger, acetate of iron, and perchloride of iron. The dose of the exceptional tinctures is from five to twenty minims, but it is as well to remember that tincture of aconite is usually given in drop doses, that children take ten drops of tincture of belladonna without difficulty, and that a drop of tincture of capsicum in an ounce mixture is quite enough to give it an appreciably hot taste, whilst ten minims will make the eyes water.

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The dose of all pills is from five to ten grains, except the pills of iodide of iron, lead and opium, phosphorus, and the compound soap and blue pills, which are usually given in somewhat smaller doses.

The dose of all solid extracts is from five to ten grains except the extracts of aconite, belladonna, colchicum, cannabis indica, and stramonium, which are given in doses of a quarter to one grain. The doses of extract of aloes is from one to three grains, and of physostigma from one-sixteenth to a quarter of a grain.

The orthodox dose of a mixture is an ounce, and the dose of a linctus is one drachm.

Some drugs are given before meals and others after meals.

Bismuth is given before meals, as it is commonly employed for its local sedative action on the mucous membrane of the stomach.

Bicarbonate of sodium, when given to increase the secretion of the gastric juice, is given before meals.

Pepsin is given after meals, as it helps to digest food.

Cod liver oil is given after meals, as it is more readily absorbed, and being of the nature of a food, would spoil the appetite if given before meals.

Permanganate of potassium is always given after meals, for if given on an empty stomach it would irritate the mucous membrane, and possibly produce ulceration.

For a similar reason bromide of potassium, in the form of tabloids, is always given after meals.

Iron is usually given after meals, especially when the astringent preparations are employed.

Arsenic is given after meals, but if only small doses are administered, better effects are produced by giving it before meals.

Hypodermic injections of morphine should always be given when the patient is actually in bed.

Pilocarpine, administered to produce sweating, should be given when the patient is in bed in a warm room.

Acetate of ammonium acts as a diaphoretic when the patient is warm in bed, but as a diuretic when the patient is in a cold room.

Sulphonal should be given two or three hours before the patient wishes to sleep, as it dissolves slowly.

IDIOSYNCRASY.

Some people are peculiarly susceptible to the action of certain drugs, in just the same way that some people are susceptible to the influence of certain articles of diet. There is the well-known case of a hospital patient, who stated that he was violently affected after eating even the smallest quantity of mutton. The house physician, disbelieving his statement, had some mutton made up into pills, and ordered one to be taken three times a day. Immediately after taking the first pill the patient was seized with diarrhœa and vomiting, which persisted for some hours.

The following instance is related on the authority of the late Dr. Roupell. A relative of his could not partake of rice in even the most minute quantity without experiencing the most distressing symptoms. Some friends, wishing to test the truth of this supposed idiosyncrasy, and knowing that he was fond of biscuits, had some made containing one grain of rice in each. They were placed near him at dinner, and he partook of two or three. He became uncomfortable and had to leave the table, observing at the same time that if he were not morally certain that he had eaten no rice, he could have sworn that he was suffering from the effects of it.

Mr. George Pollock relates the story of a man who could not eat gooseberries without their producing an eczematous eruption all over the body. Dining out one night he was induced to taste a special brand of champagne. A few minutes later, turning to his host, he remarked that the wine was not champagne at all, but was made out of gooseberries, and, pulling up his shirt sleeves, showed the specific eczematous rash, as a proof of the correctness of his statement.

I have recorded the case of a man who could drink practically any amount of red wine or spirits, but who was reduced to a condition of collapse by a single glass of champagne.

Some people cannot take certain kinds of fish without suffering acutely, whilst numerous instances have been recorded of people who have suffered severely from urticaria after eating strawberries.

Singers often lose their voices after being in a room with flowers, which have a powerful odour; and many people become asthmatic after smelling violets, wallflowers, or privet.

The idiosyncrasy with respect to drugs is well established. The majority of people can take five grains of iodide of potassium without suffering any inconvenience, whilst there are particular individuals who cannot take even a single grain without exhibiting the symptoms of coryza, accompanied by gastric catarrh and intense mental depression.

The susceptibility to the bromides is not so common, but there are people who cannot take half a dozen doses without getting a well marked acne rash all over the face and body. When the patient is an epileptic this is a serious matter, for either he is unpresentable on account of his spotty condition, or he is afraid to go out from the liability to the occurrence of the fits. A few years ago a new bromide—

the bromide of strontium—was introduced, which was said never to produce an eruption on the skin. I tried it in many cases with good results, but then there came a patient in whom it produced acne, and it was clear that the strontium salt had no advantages over its congeners.

Some people cannot take quinine even in the smallest dose without getting singing in the ears, whilst others are equally susceptible to the action of iron.

Many people either will not or cannot take narcotics.

Of course there is a good deal of fancy in these cases, and many a patient who says he cannot take opium takes compound soap pills without difficulty, just as patients who say they are peculiarly susceptible to arsenic make no objection when they find they are taking Fowler's solution.

Some time ago I ordered apomorphine for a lady as an expectorant. She read the prescription, and the next day informed me that the medicine had made her so drowsy that she was unable to keep her eyes open. I endeavoured to explain to her that apomorphine had none of the properties of morphine, but she remained unconvinced.

That many people are susceptible to the action of powdered ipecacuanha is well established. It usually produces coryza and then a sharp attack of dyspnœa. This has been tested over and over again, and there is no doubt about the fact. Powdered colocynth—which is largely employed for keeping furs free from moth—has a similar effect.

This idiosyncrasy with respect to the action of drugs is not easy to explain. The untoward effects produced are not always identical with the toxic action of the drug. It is not always that the patient is peculiarly susceptible to the drug, but that in certain individuals, symptoms are produced which are not observed in other people. It is probable that in many cases the idiosyncrasy is temporary

rather than permanent, and that it may be the result of or at all events associated with certain other conditions which aid in its production. For example, the action of calomel is said to differ according to the amount of salt in the system. It is asserted that when patients are kept on a low diet almost free from salt, calomel exerts very little action, but that when given to people who have been fed on salt meat, sailors for instance, it acts as a violent gastro-intestinal irritant. This may not be exactly a case of idiosyncrasy, but it shows that the condition of the body influences its susceptibility to the action of drugs.

TOLERATION AND HABIT.

Toleration with respect to certain drugs is very easily established. The story is told of a man who established tolerance in the case of so many drugs that when he wished to commit suicide he could find no poison which would affect him.

The most familiar example of toleration is afforded by tobacco. The experiences of a novice in the art of smoking are by no means pleasurable. He vomits, he is purged, he suffers from distressing giddiness, he is deadly pale, his pulse is weak and thready, and the whole body is covered with a cold, clammy sweat. And yet in few days or in a few weeks at the outside, he becomes so habituated to the use of the drug that he can smoke all day without inconvenience. Very often the tolerance is not complete, for the habitual cigarette smoker may be made decidedly uncomfortable by a cigar or pipe. Even in the matter of cigarettes, there is a difference, for the man who smokes Virginian straight cut cigarettes to the tune of twenty or thirty a day, may be upset by a single Egyptian cigarette.

The explanation may be that some Egyptian cigarettes contain a small quantity of cannabis indica, or the tobacco may have been grown on ground on which the opium poppy had previously been planted. Some people smoke with comfort and enjoyment only after meals or after taking alcohol; they find that they cannot smoke after drinking tea, and it is a common experience that tobacco goes well with coffee and badly with tea.

Another familiar example of tolerance is afforded by alcohol. A person who is a total abstainer may be made decidedly uncomfortable by "tipsy cake," whilst there are many men who will put away a couple of bottles of champagne without inconvenience. Many habitual topers are so accustomed to the use of the drug that they never get drunk. They may be "muddled," or heavy and sleepy, but they know perfectly well what they are doing, and are quite able to execute delicate manipulations to which they are accustomed, with ease and accuracy. For example, a soubrette may delight her audiences with her singing, and may even dance, when she is so drunk that she can hardly stand. A steeple-jack will go up a two hundred feet ladder with ease, when he cannot walk straight on level ground.

Tolerance is soon established in the case of coffee. Many people, if they are not accustomed to it, suffer from wakefulness on first taking black coffee after dinner. Soon, however, this susceptibility passes off, and, after a few days, they take it with impunity. If, however, they abandon the custom they experience the same difficulty on resuming it. Many people who can take ordinary coffee are kept awake by "special coffee," which is extra strong.

The best example of tolerance is afforded by people who, from long habit, are accustomed to take large doses of opium. They soon get habituated to its use, and take it with the view of inducing its primary or stimulating effects. In the

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case of De Quincey, this stage usually lasted about eight hours, and he was enabled to time the exhibition of his dose so that its narcotic influence corresponded to the natural hours of rest. Not infrequently he indulged in an opium debauch before going out to dinner, or preparatory to a visit to the opera. This, however, was not always the case, and, in common with most opium eaters, he resorted to the drug when he could enjoy its effect in perfect quiet. He says:—

"I will admit that markets and theatres are not the appropriate haunts of the opium eater when in the divinest state incident to his enjoyment. In that state crowds become an oppression to him; music even too sensual and gross. He naturally seeks solitude and silence, as indispensable conditions of those trances or profoundest reveries which are the crown and consummation of what opium can do for human nature. . . . The remedies I sought were to force myself into society, and to keep my understanding in continual activity on matters of science. But for these remedies, I should certainly have become hypochondriacally melancholy. In after years, however, when my cheerfulness was more fully re-established, I yielded to my natural inclination for a solitary life. And at that time I often fell into those reveries upon taking opium, and more than once it has happened to me when I have been at an open window, in a room from which I could overlook the sea at a mile below me, and could command a view of the great town of L——, at about the same distance, that I have sat from sunrise to sunset motionless, and without wishing to move."

There is no doubt that many brilliant conversationalists, before dining out, take opium to stimulate their mental faculties. If, however, the dinner is delayed the effect is unfortunate. I remember one man—an opium eater—who went to sleep after the soup and could not be roused until th

We have another example of tolerance in the case of the arsenic eaters of Styria. They begin with a small dose, and gradually increase the quantity as they become accustomed to its effects. The tolerance, however, is not permanent, for, if the arsenic eater leaves his native country and abandons the habit, he cannot resume it with impunity on his return.

It is said that in some cases tolerance has been established in the case of corrosive sublimate, and that there are people who can take very large doses with impunity.

A very good example of tolerance is afforded by sulphate of zinc. Ordinarily this salt acts as an emetic, and thirty grains will promptly evacuate the contents of the stomach. In many nervous diseases, such as chorea, large doses may be given with advantage. If the quantity is gradually worked up to, as much as twenty grains may be given every two hours, without producing nausea or inconvenience of any kind.

Tolerance is quickly established in the case of coniium, and if the dose is gradually pushed, patients will take enormous doses of the succus without the induction of the ordinary physiological effect. With care even an ounce may be given hourly with safety.

ACCUMULATION.

Some drugs are said to be "cumulative," and what is generally understood by this expression is that the patient goes on taking a certain medicine up to a particular point when quite suddenly he suffers from untoward symptoms. This is true to a certain extent, but it is not the whole truth. Digitalis is commonly quoted as an example of a cumulative drug, and what happens is this. Digitalis is a diuretic, and is eliminated by the urine. Whilst the patient is taking the drug he may catch a cold or meet with some

disturbance of the system which leads to an interference with the action of the kidneys. The drug is no longer eliminated, and the result is that a larger percentage is present in the blood and produces toxic symptoms.

We get pretty much the same kind of thing in chronic lead poisoning. The poison circulates slowly, becoming assimilated and eliminated in nearly equal quantities, until an increase in the dose, an arrest in the elimination, an affection of the kidney, a weakening of the vital powers, or possibly an exhaustion of the tolerance of the animal economy, or all of these combined, allow the phenomena of acute or chronic lead poisoning suddenly to declare themselves.

INCOMPATIBILITY AND ANTAGONISM.

Incompatibility may be either chemical or physiological. It is easy to give examples of the former variety. A student is told to prescribe for a patient suffering from dyspepsia. He writes out the formula for a gentian and acid mixture containing fifteen minims of dilute hydrochloric acid in each dose. The patient mentions casually that she is "troubled with the wind," and the student, knowing that sal volatile is "good for flatulence," adds half a drachm of the aromatic spirit of ammonia to each dose, regardless of the fact that the hydrochloric acid neutralizes the ammonia.

Chemists are very fond of telling us that certain combinations are incompatible, although in reality they are not so. For example, we are constantly warned not to give iron with vegetable infusions containing tannic acid "because they are incompatible." As a matter of fact they are not incompatible. The tannic acid combines with the iron to form tannate of iron, which is black, and consequently makes an unsightly

mixture; but therapeutically it is active enough, and is readily absorbed by the stomach. A prescription which would be rejected on purely chemical grounds may be therapeutically active. For example, an injection might be ordered containing acetate of lead and sulphate of zinc with rose-water. It is true that the sulphate of lead formed by the double decomposition would be precipitated, but this finely divided acetate of lead, when shaken up, would form a very valuable application in a case of gonorrhœa.

Some combinations of drugs are explosive. For example, chlorate of potassium and gallic acid, ordered to be dispensed in powder for the patient to dissolve in water to form a gargle, exploded violently, and resulted in a serious accident to the pharmacist. A mixture of chlorate of potassium, tincture of perchloride of iron and glycerine exploded when kept in a warm place. Chromic acid readily parts with its oxygen and explodes when mixed with glycerine. Oil of turpentine and sulphuric acid explode violently when mixed, and amber oil, for the same reason, should not be dispensed with nitric acid. It is not wise to prescribe oxide of silver or nitrate of silver with creasote in the form of a pill. Permanganate of potassium and glycerine form a dangerous combination, and it is not safe to prescribe permanganate of potassium in a pill with extract of gentian, or the whole mass may go off suddenly. The proper excipient in this case is kaolin or Chinese chalk. A simple example of an explosive combination is afforded by putting a few chlorate of potassium tabloids and a box of safety matches in the overcoat pocket.

Antipyrin gives us two good examples of incompatibility. When mixed with spirit of nitrous ether it forms green crystals, and with salicylate of sodium an oily liquid. Chloral is decomposed by alkalies and should not be given with liquor potassæ or with ammonia.

There are certain mixtures which, although not incompatible, are inexpedient. No one, for example, should prescribe tincture of capsicum in an effervescing mixture, for the patient, in taking a dose, will be in danger of being half blinded by the hot pepper.

Physiological incompatibility is of much greater importance, and, curiously enough, it is a subject to which but little attention is paid, for it is very common to come across prescriptions containing drugs absolutely antagonistic in action. For example, pilocarpine will not produce sweating if administered with atropine. No student who knows his pharmacology is likely to fall into the error of prescribing physiological incompatibilities.

Sometimes, however, a prescription is "bad," both on chemical and pharmacological grounds. For example, a man prescribes strychnine with bromide of potassium. This is bad, for these two drugs are physiologically antagonistic. But it is worse chemically, for after a few hours an insoluble bromide is formed which settles to the bottom of the bottle, so that the patient gets the whole of it with the last dose. The bromide may be in sufficient quantity to form a chemical compound with the strychnine, but not to counteract its powerful physiological action. We have a similar example when acetate of morphine is prescribed with bicarbonate of potassium or carbonate of ammonium.

There was at one time considerable difference of opinion as to whether drugs could be mutually antagonistic. The opponents of the theory of mutual antagonism maintain that whilst one drug increases, another depresses or suspends function, and that the drug which increases function can never overcome the effect of a drug that has abolished function. The advocates of the theory of mutual antagonism point out that atropine will antagonize the action of muscarine, and muscarine the action of atropine, on the

heart; that atropine will antagonize the action of pilocarpine on the submaxillary gland and *vice versâ*, and that, moreover, if, after atropine has antagonized the effects of pilocarpine, a further quantity of pilocarpine is administered, it will overcome the action of atropine, and that the salivary secretion will be re-established; and, finally, that lime and potash, which excite the same action on the frog's ventricle, when administered simultaneously do not produce the sum of their united action, but one drug lessens the effect of the other. The weight of evidence is clearly in favour of the latter view, and we are justified in assuming the existence of mutual antagonism between certain drugs. If further evidence were required it is afforded by the fact that in experiments with Roy's apparatus, when the ventricle only is employed, chloroform and ammonia are found to be mutually antagonistic. Iodoform and ammonia are also mutually antagonistic with regard to their action on the whole ventricle.

It is not difficult to find examples of physiological antagonism:—

	Antagonise.	
Belladonna Hyoscyamus Stramonium Atropine Homatropine Hyoscyamine Duboisine Jaborine Jaboridine	with respect to secretions	Jaborandi Pilocarpine Pilocarpidine Muscarine Picrotoxin
	on the heart	Aconite Aconitine Muscarine
	as regards general action, but only partly	Opium Morphine Codeine
Digitalis	on the heart	Aconite Aconitine

Nux Vomica Strychnine Brucine Thebaine Calabarine	on the cord	Physostigma Physostigmine Chloral Hydrate Paraldehyde Bromides

THE ART OF PRESCRIBING.

Very few students know how to prescribe, and yet there is very little difficulty about it. The only thing necessary is to know a few doses. Let us take a simple prescription and see what we can make of it. A patient has a hacking cough, unaccompanied by expectoration, for which we want to prescribe small doses of morphine, to be taken frequently in the form of a linctus. The ordinary dose of the liquor morphinæ acetatis, or liquor morphinæ hydrochloratus—for it is a matter of indifference which we prescribe—is fifteen minims; but if we give three minims at a dose, it is sufficient to check the cough without disturbing the stomach or producing constipation. If it is to be taken frequently, the actual quantity of fluid prescribed should not be large, and it should be more or less sticky or mucilaginous, so that it will hang about the back of the throat. The following prescription answers the purpose admirably:—

Solution of hydrochlorate of morphine ...	3 mins.
Spirit of chloroform	3 mins.
Syrup of lemons	½ dr.
Water	to 1 dr.

If we want to give this in a four-ounce bottle with teaspoonful doses, it is simply a matter of multiplying by the number of drachms in four ounces, that is by thirty-two,

or, for the sake of convenience, let us say thirty, when the prescription assumes this form—

Solution of hydrochlorate of morphine ...	1½ drs.
Spirit of chloroform	1½ drs.
Syrup of lemons	2 ozs.
Water	to 4 ozs.

A tea-spoonful occasionally.

If we wish to make a change in the taste of the medicine, we substitute, for the syrup of lemons, simple glycerine or syrup of tolu, or a somewhat smaller quantity of syrup of Virginian prune; and we may, if we are so inclined, dilute any of these with mucilage of acacia. If, in addition, we want to give an expectorant, we add five minims of ipecacuanha wine to each dose. We have at least half a dozen prescriptions ready for use, and all formed on the same model.

Then take the ordinary gentian and sodium mixture, so commonly used in the treatment of dyspepsia. It runs as follows:—

Bicarbonate of sodium	15 grs.
Spirit of chloroform	15 mins.
Compound infusion of gentian ...	to 1 oz.

If we wish to make this stronger, we put in half a drachm of compound tincture of gentian, and if we wish to make it more palatable, we add half a drachm of tincture of orange peel, or syrup of orange. If we wish for a sedative action on the stomach, three minims of dilute hydrocyanic acid will not be amiss; whilst, if we desire a carminative action, there is no objection to ten minims of tincture of ginger. To obtain a tonic effect, some of the other ingredients may be replaced by ten minims of tincture of nux vomica. This mixture being alkaline, is usually given a quarter of an hour before meals, to increase the secretion

of the gastric juice, but if we prefer giving a medicine after meals, all we have to do is to substitute for the bicarbonate of sodium fifteen minims of dilute hydrochloric acid. When we are tired of the infusion of gentian we replace it by tincture and infusion of quassia or calumba, so that we have an entirely new series of prescriptions. It is a very simple matter, and, from a basis of a single formula, we find ourselves in possession of a couple of dozen prescriptions.

The ordinary tonic quinine mixture is capable of being manipulated in a very similar way. The usual formula is—

Sulphate of quinine	16 grs.
Dilute sulphuric acid	½ dr.
Water	to 8 ozs.

Two table-spoonfuls three times a day, before meals.

The taste of this mixture can be altered by substituting cinnamon water for ordinary water, or by adding ten minims of tincture of orange-peel and half a drachm of simple syrup to each dose. The addition of a couple of grains of sulphate of iron to each dose, converts the sulphate of quinine mixture into a mixture of iron and quinine.

The ordinary perchloride of iron mixture presents no difficulty.

Tincture of perchloride of iron	15 mins.
Spirit of chloroform	15 mins.
Glycerine	15 mins.
Water	to 1 oz.

If it is thought desirable to give digitalis, all that is necessary is to add a couple of drachms of the freshly prepared infusion, but as this makes a black and unsightly mixture, the addition of fifteen drops of dilute phosphoric acid is an advantage.

The best pill for anæmia and chlorosis is the following:—

Dried sulphate of iron, five grains;
Simple syrup, enough to make a pill.

The pills are quite hard, but when thrown into water rapidly disintegrate, the salt being deposited in a form in which it is rapidly absorbed by the stomach. These pills should never be made with vegetable extracts, or they will form a sticky mass which is but slowly soluble, and not uncommonly irritates that portion of the mucous membrane of the stomach with which they come in contact. Five grains of the dried sulphate of iron are equivalent to nine grains of the crystalline salt, and as most patients take without difficulty two pills three times a day after meals, the amount of iron administered is considerable. The addition of one-hundredth of a grain of arsenious acid to each pill is often advantageous. These pills are apt to constipate, and in cases of anæmia little benefit is derived from iron unless the bowels are kept well open.

An excellent purgative pill is the following:—

Calomel, three grains;
Extract of hyoscyamus, enough to make a pill.

This pill, if taken at bedtime, usually acts well and comfortably, without causing inconvenience. The henbane prevents griping and straining.

A student who commences professional life with half a dozen prescriptions—the gentian and sodium mixture, the quinine mixture, the iron mixture, the morphine linctus, the iron pill, and the calomel pill—will not do badly. At all events, he will not be in the position of the man who said that his difficulty was not so much in prescribing the right thing, as in prescribing anything at all.

The beginner, in what may be called the experimental stage of his prescribing life, should not attempt any wide range, but should limit himself to accurately observing and acquiring a knowledge of—

1. The value of small doses of tincture of aconite

frequently repeated in the treatment of tonsillitis, and in the initial stage of febrile diseases.

2. The value of painting the chest and back with iodine liniment—diluted if necessary with an equal quantity of the tincture—in all cases attended with cough.

3. The value of the dried sulphate of iron pill in conjunction with purgatives in the treatment of anæmia.

4. The value of grain doses of grey-powder with an equal quantity of Dover's powder three times a day in the treatment of syphilis.

5. The value of large doses of the iodides in the treatment of tertiary syphilis.

6. The value of large doses of bromide of potassium in the treatment of the "heats and flushes" and other symptoms from which women suffer about the time of the menopause.

7. The value of quinine in the treatment of supra-orbital neuralgia, and in the periodical febrile disturbance from which old malarial patients suffer.

8. The value of five grains of butyl-chloral-hydrate with one two-hundredth of a grain of gelsemine in neuralgia of the fifth nerve.

9. The value of small doses of a saturated solution of camphor in alcohol in the treatment of autumnal or choleraic diarrhœa.

10. The value of small doses of perchloride of mercury in the treatment of infantile diarrhœa when the stools are green, slimy, and offensive.

11. The value of sulphide of calcium in doses of a tenth of a grain in the treatment of boils, carbuncles, and abscesses.

12. The value of nitroglycerine and nitrite of amyl in the treatment of angina pectoris and allied conditions.

13. The value of alcohol in the treatment of fevers.

14. The value of flying blisters in typhoidal conditions.

THE APPLICATION OF HEAT AND COLD.

Heat and cold, in their actions on living organisms, have long been the subject of study and experimentation, and many interesting and curious facts have been determined by these researches.

Heat.—A distinction must be made between wet heat and dry heat. It is found that whilst it is impossible for a man to keep his hand in water at a temperature of 124° F. he can remain five minutes in air at a temperature of 200° F. without much inconvenience. If the air is perfectly dry, a temperature of from 280° to 300° F. can be sustained.

Various observations on the effect of heat have been made on the lower animals.

Lautenbach has shown that heat, when applied to the motor nerves of frogs, produces movements in the muscles both by its action as a simple irritant and by its destructive effects. Heat acts as a simple irritant at temperatures ranging from 68° F. to 135° F. The influence which these moderate degrees of heat exert on the motor nerves resembles that induced by the galvanic current, in that muscular contractions commonly occur either on bringing the heated object in contact with the nerve or on removing it.

When the foot of a frog is placed in warm water reflex movements are produced. These reflex movements occur at a lower temperature in the case of the posterior extremities than of the anterior. The lowest degree of heat applied in the form of hot water which produced reflex movements in the posterior extremities of the frog was 84° F.

Dry heat produces little or no effect on certain kinds of frogs. The *Ranæ esculentæ* allow themselves to be burnt freely with a hot iron without resenting it in any way.

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This is not true of all frogs, for the *Ranæ temporariæ* and the various kinds of toads move off directly if touched with heated metals. In the case of the esculenta frogs it is not only the skin which is impervious to the action of dry heat, but the nerve trunks themselves are absolutely insensible to this method of irritation. It is only to dry heat that the *Ranæ esculentæ* are insusceptible, for they display the greatest possible objection to the application of moist heat. When the hind legs of one of these frogs is dipped into oil at a temperature of 205° F. vigorous reflex movements are induced, but when the leg is brought in contact with the metal vessel containing the oil, which is of course at the same temperature, no effect results. In the same way, when a piece of metal is dipped in the hot oil and wiped dry it in no way incommodes the frog.

Some mammals experience no pain from the application of a very hot iron. For example, a deep burn made in the ear of a large brown rat seemed only to tickle the animal. It brushed its ear with the anterior extremity of the same side—a movement identical with that which it had previously made when the ear was tickled with a feather—but it made no effort to escape. When, however, the iron was allowed to cool, the slightest touch obviously gave pain. Burning its tail with a very hot iron caused the animal to lazily turn its head and smell the burning part. Touching the skin with hot water immediately gave rise to frantic efforts to escape.

The same apparent indifference to the application of a hot iron has been observed in the case of pigs.

Some people seem rather to like the application of the actual cautery. A patient of mine who was paralyzed had it applied to his spine several times, and refused an anæsthetic, maintaining that the sensation was rather pleasant than otherwise.

The heart of a frog exposed to a high temperature soon becomes unduly frequent and fails to contract properly. The explosion of the contractive substance is prematurely induced before a sufficient supply of explosive material is accumulated, so that each stroke becomes more and more feeble, and as the rate is quickened the beats become irregular and finally cease.

The influence of heat and cold modifies the action of veratrine on muscle, and, reasoning from analogy, it is probable that temperature modifies the action of other drugs, not only on muscle, but on nerves and nerve-centres.

The effects of heat on the human body vary with the degree of heat, the slowness or rapidity of transition from a low to a high temperature, and also with the length of exposure. Other modifying conditions are met with in the constitutional state of the individual, in the amount of moisture in the atmosphere, and in the condition of the health.

The range of temperature within the limits at which life can be maintained is greater in the case of man than in any other animal.

Dry heat can be borne with much less inconvenience than moist heat. In one case a temperature of 210° F. was sustained for twenty minutes, and in another a temperature of 260° F. was sustained for eight minutes. Workmen have been known to enter a drying-oven in which the thermometer stood at 350° F. Stokers often carry on their work at temperatures of from 120° to 160° F. In these cases the profuse perspiration which is induced exerts a cooling influence, and prevents any material rise in the temperature of the body.

Moist heat is much more prejudicial, and few people are able to remain in a vapour bath, at a temperature of 120° F., for more than a few minutes.

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The effects experienced by those exposed to a great heat vary with the temperature, the duration of the exposure, the moisture of the air, and the amount of the effete material in the atmosphere. The first sensation is usually agreeable, but this is succeeded by one of heat and oppression, which is relieved as perspiration becomes profuse. The initial stimulation of the nervous and muscular systems is rapidly followed by a feeling of languor and depression, so that mental effort is an exertion, and there is a tendency to dizziness and faintness. If the temperature continues to rise or is long maintained, the symptoms induced resemble those of sunstroke.

A person exposed to a high degree of heat is safe so long as his temperature does not rise more than ten degrees above the normal.

The usual cause of death in people exposed to a high degree of temperature is heart failure. The cardiac myosin coagulates at a temperature of 115° F., and even at a much lower temperature its condition is seriously affected. The regulative heat mechanism is unable to withstand the strain of too great an external heat, or of too prolonged an exposure to a great, but less degree of heat. It is possible that the chain of events leading to death may not take exactly the same course in every case, but there can be no doubt that a high temperature increases the metabolism of the various tissues. Mammalian muscles become rigid at 120° F., but death always occurs before that temperature is reached by the blood.

The most convenient method of applying heat to the body is by means of a hot bath.

It may be convenient to indicate the temperatures of various baths :—

A cold bath is a bath the temperature of which is below 70° F.

A tepid bath ranges in temperature from 85° to 95° F.

A warm bath is a bath between 96° and 104° F.

Hot baths have a temperature from 102° to 110° F.

A hot bath is more easily borne if the temperature of the water is gradually raised.

The effect of an indifferent or tepid bath is not very marked, and is almost confined to the peripheral extremities of the nerves. There is no excitation of the nerve centres or of the circulatory system. Neither the pulse nor the secretions are affected, and the temperature of the body remains unaltered.

The general warm bath produces sensations which are generally agreeable. The pulse and respiration become more frequent, and there is dilatation of the blood-vessels of the skin followed by perspiration.

If the bath is very hot the pulse is greatly increased in frequency, and the respiration becomes anxious and quickened. There is a sensation of throbbing in the head and the blood-vessels pulsate violently.

Hot baths are employed therapeutically in the early stages of a cold, in bronchitis, in the treatment of renal and biliary colic, in Bright's disease, in chronic rheumatism, and in painful menstrual disorders.

The duration of the bath will depend on the age and strength of the patient, on the nature of the affection from which he suffers, and on the temperature of the water. A very hot bath can be borne for only a few minutes, but in some chronic skin diseases patients are kept in a tepid bath for many consecutive hours.

The local application of heat in the form of a douche, foot-bath, or sitz-bath, has much the same effect as a general warm bath, but on a smaller scale. The blood-vessels are dilated, and the vascular distension extends to the adjacent parts. A hot foot-bath with or without the addition of

mustard is useful at the onset of a cold, whilst the sitz-bath is frequently resorted to by women, whose menstrual flow is retarded or suspended. In the case of the sitz-bath, the effect is produced by the dilatation of the blood-vessels of the pelvic viscera.

There are many different kinds of composite liquid baths, such as the sea-water bath, the alkaline bath, the nitro-muriatic bath, the bran bath, the seaweed bath, the pine bath, the mustard bath, and so on.

In addition to the warm bath, heat may be applied to the body in the form of vapour. This is commonly known as a vapour bath, and it assumes two forms, one in which the vapour is inhaled as in an ordinary Turkish or Russian bath, and the other in which the steam is applied to the body enclosed in a box, the head protruding through an aperture in the lid. A vapour bath is usually given at a higher temperature than a water bath, but 122° F. is the limit which is readily borne. The vapour bath produces profuse perspiration, and is useful in a great number of painful chronic affections. In the Turkish bath the patient has a cold douche before going out in the open air to contract the blood-vessels of the skin.

In some bathing establishments flagellation is resorted to, in order to stimulate certain dormant energies. In London instruments for this purposes are supplied at the brush shops. The mode of treatment is a favourite one with old men.

Heat employed in the form of the Paquelin cautery acts as a counter-irritant. The custom of "firing" stiff joints is a very old one. The Paquelin cautery is used with advantage over the region of the spine in many cases of chronic paralysis. The application is not so painful as might be supposed.

Poultices and fomentations are practically local hot baths

applied to the skin. A poultice is a pultaceous mass composed of materials which swell up on the application of boiling water. They are usually made from oleagenous seeds, such as linseed. They are applied hot to inflamed portions of the skin to promote absorption or disintegration of the products of inflammation. The warmth and moisture relax the tissues and abate the tension due to inflammation. When matter has formed, poultices or fomentations facilitate its passage to the surface and subsequent expulsion, whilst limiting the spread of inflammation in other directions. A poultice prevents evaporation from the skin; the water being held by the pultaceous mass does not penetrate the skin, and prevents it from being sodden. Dry heat would cause irritation, whilst the simple application of hot water would injure the skin by imbibition.

Cold.—The general effect of cold on the system is to lower vital activity and the metabolism of the tissues.

Cold, however, varies in its effects according to the degree, the duration of exposure, and the extent and manner of its application.

Moderate cold applied for a brief interval acts as a tonic, and is followed by a stage of reaction.

Dry cold is much less injurious in its effects than moist cold, or cold accompanied by wet. Immersion in water cools much more rapidly than exposure to air at the same temperature, and a constant renewal of the cooling medium materially hastens the reduction of the temperature of the body. It is a common experience that sitting in a draught of only moderately cool air is much more likely to produce a chill than a lower temperature when the air is still.

One of the first effects of exposure to extreme cold is, er a brief period of congestion, contraction of the blood- the capillaries contracting to such an extent as to passage of the blood corpuscles. The diminished

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metabolism which quickly ensues influences first and chiefly the central nervous system, especially the brain and those centres which are concerned in the maintenance of consciousness. This condition is intensified by the slowing of the heart and the interference with respiration. The result is the production of a drowsiness which is akin to sleep, but differs from it in the tendency to pass insensibly into death.

Some warm-blooded animals, scattered members of several groups of mammalia, assume every year a condition of hibernation or winter-sleep. The heart beats slowly, the respirations are few and far between, and there is a diminished activity of the tissues, the various functions of the body being practically held in abeyance. This condition is due partly to cold, but not entirely, for in the case of the dormouse the animal will fall into its winter sleep at a temperature considerably higher than that at which it awakes in the summer.

The influence of cold on the frog's heart closely resembles that of atropine. Both diminish the number of beats, prolong and strengthen the systole, prolong the diastole, and increase the diastolic dilation of the ventricle. The diastole is prolonged much more than the systole.

Cold may be applied in the form of a cold bath, as a douche, by wet packing, by cold compresses, in the form of an ice-bag, or by irrigations, lotions, or injections.

Cold baths have a marked influence in lowering not only the surface heat, but the temperature of the body generally. The immersion of a patient in a bath at 60° F. for ten minutes reduced the axillary temperature from normal to 94·6° F., and the temperature in the rectum by a degree and a half. The temperature, even after a prolonged immersion, is rapidly restored, the normal being usually regained in a little over half an hour.

The first effect of a cold bath is to produce shivering,

blueness of the lips, nose, and extremities, a fall in the temperature of the skin, a quickened pulse, and convulsive sobbing breathing. A condition of reaction soon ensues, the skin becomes ruddy and glowing, the breathing full and easy, and the pulse quick and strong. If the bath is prolonged a condition of depression again ensues, the patient gets blue and shivers, and experiences a feeling of depression and wretchedness. The art of taking a cold bath is to stay in it just sufficiently long to ensure a good reaction. The explanation of the feeling of mental exhilaration which is experienced by healthy people after taking a cold bath is that there is contraction of the vessels of the skin and an increased supply of blood to the internal organs.

The effect of a cold douche is very much the same as that of a cold bath, but as it exerts a much more depressing influence on the system, the application must be of short duration.

In wet packing the patient lies extended on two blankets, over which is placed a sheet wrung out as dry as possible with cold water. The patient is then tucked in tightly with the blankets, and is left to perspire for as much as he is worth. This wet pack is largely employed in a number of diseases, including specific fevers, rheumatism, and inflammatory affections.

The ice-bag to the spine has been extensively lauded as a remedy for sea-sickness and many functional nervous diseases.

The cooling lotion so generally employed in surgical affections consists of two and a half ounces of rectified spirit and half a pint of water, with or without the addition of four drachms of nitrate of potassium or chloride of ammonium.

The use of ether sprayed on the part as a means of inducing local anæsthesia is so well known as to call for but

little comment. The ether must be the pure anæsthetic ether, and its effects are available only for minor operations. A certain amount of pain is experienced as the part thaws, and in people of feeble circulation chilblains sometimes result.

LIGHT AS A THERAPEUTIC AGENT.

There is good evidence to show that light, and especially direct sunlight, exercises a beneficial influence in maintaining the general standard of health. The Italians have a proverb to the effect that where the sun does not enter the doctor does, whilst amongst the Indians there is a saying that "He who plants a tree in the front of his dwelling begins to dig his own grave." In connection with this subject, reference may be made to a paper "On the Influence of Light upon Protoplasm," published in the Proceedings of the Royal Society, by Dr. Arthur Downes, now of the Local Government Board, and Mr. Thomas P. Blunt. In this valuable and suggestive paper it is shown by a series of elaborate experiments that light is inimical to, and under favourable circumstances may wholly prevent, the development of bacteria and organisms associated with putrefaction and decay. An attempt was made to ascertain with what part of the spectrum this property of light was associated, and the conclusion arrived at was that it depended chiefly on the blue and violet rays.

Practical men have long recognized the value of direct sunlight in the treatment of disease. Dr. Pollock states that a freckled child is rarely consumptive. He says that there is not only mental invigoration in sunlight, but there are vital agents assisted and possibly developed by it. Dr. Hermann Weber bears equally emphatic testimony as to the value of sunlight, and suggests that, when possible,

patients suffering from consumption should be placed on a terrace or balcony sheltered from cold winds, but exposed for many hours during the day to the full direct rays of the sun.

It is important in the selection of a place of residence for a person suffering from lung trouble that the aspect should be due south. The best arrangement is to have the sitting-room on the ground-floor, and the bedroom immediately over it. When from necessity both rooms are on the same floor, the sitting-room should face the south, and the rooms should communicate by folding doors, which should be left open during the day, to permit of the sun shining through them into the back room.

Reflected sunlight is not without a beneficial influence, and when rooms on the same floor face east and west, it is quite easy to arrange half a dozen small mirrors so that during many hours of the day both rooms get the benefit of the sunlight. If the mirrors are objected to on the ground that they are not sufficiently ornamental, they can be painted with flowers, should that special form of art excite the fancy of the occupants of the rooms. The typical housewife is very fond of pulling down the window-blinds when the sun shines to save the carpet from fading, but this is paltry economy, which should not be tolerated for one moment.

Attention may be called in this connection to an interesting paper by Siemens, "On the Influence of Electric Light on Vegetation." He showed that plants progressed much more readily, and attained a much higher degree of development, when subjected to the influence of sunlight by day and of electric light by night, than when exposed to the action of sunlight only. It is true that he experimented with an electric light of 1400 candles driven by a three-horse power Otto gas-engine, but for indoor work a light of much less intensity would suffice. It is conceivable that

anæmic and consumptive patients would make better progress in a house well lighted with electricity, especially in London during the winter months, when the sun is rarely seen and the hours of daylight are short. Electricity as a lighting agent can now be obtained at so small a cost that the experiment is worth trying.

VENESECTION, LEECHING, AND CUPPING.

Venesection or bleeding as a therapeutic agent was at one time universally practised and is now almost as universally condemned.

In times past bleeding as a remedy was apt to be employed inopportunely, to be misdirected, or to be pushed beyond its proper and safe limits; but of late, medical practice has rushed to the opposite extreme. Men and women often bear large losses of blood with impunity; men from wounds on the battlefield and in accidents, women from floodings from the uterus; and this not only during health, but also when the strength has been reduced by disease.

There can be no doubt that the routine employment of venesection in inflammatory diseases was a grave mistake, seeing that it did no good but brought with it evils of its own.

There are many diseases and conditions in which venesection is distinctly harmful.

It is counter-indicated in enteric and all other specific fevers. It is distinctly injurious in acute rheumatism and does no good in cases of hyperpyrexia.

It is useless in pneumonia, pleurisy, pericarditis, and peritonitis, although possibly in cases of pneumonia accompanied by marked cyanosis some relief might follow.

It is of very doubtful benefit in cases of hæmorrhage, although in one case of hæmoptysis where the blood had

run down the trachea into the bronchi and the patient was livid, it produced a markedly beneficial effect.

Venesection is useful in some cases.

In the eclampsia from uræmia, including puerperal convulsions and those of advanced Bright's disease, it is distinctly indicated.

It is useful in those forms of epilepsy where convulsions are long continued, or the patient passes into the status epilepticus with impeded respiration and blueness of the surface.

In apoplexy it is indicated in the condition of insensibility, which is accompanied by cyanosis and stertorous breathing.

The pain of aneurysm is often relieved by small bleedings, but equal benefit is usually obtained by the use of iodide of potassium, nitrite of amyl, or nitroglycerine.

The most marked indication for bleeding is general venous congestion with cyanosis, dyspnœa, turgid veins, enlarged liver, albuminaria, pulsation in the jugular veins and at the epigastrium, functional incompetence of the tricuspid valve, and a small weak and fluttering radial pulse.

Leeching and Cupping are now rarely employed as therapeutic agents. The trade in leeches has dwindled to a miserable fraction of its former magnitude, and the art of cupping and the once thriving and useful race of cuppers are extinct. The consumption of leeches must at one time have been very considerable, for it is stated that the four principal dealers in London imported on the average 600,000 a month, or 7,200,000 a year. In France 100,000,000 leeches a year were employed. At the present time the use of leeches seem to be confined almost entirely to the ophthalmic surgeons. Leeches abstract blood from the capillaries and smaller blood vessels, and the effect is that

of local bleeding. The quantity of blood which a leech is capable of drawing varies considerably, and four drachms is probably the maximum. The average capacity of a leech is about a drachm and a half. When a leech has had sufficient it drops off, but if its tail is snipped it does not perceive the fact and goes on sucking, the superfluous blood running out at the other end.

A good many accidents are reported from the use of leeches. A young man had leeches applied to his anus and one of them made its way into the rectum. A lady who was applying a leech to her gums accidentally swallowed it. Some one remembered that leeches could not live in alcohol and advised the administration of brandy and water hourly. The lady reluctantly adopted the remedy, but it was three weeks before she was satisfied that the animal was dead.

There are two kinds of cupping, wet cupping and dry cupping. Wet cupping is practically scarification, a number of superficial parallel cuts being made with a set of sharp lancets. Dry cupping is the application to the skin of a glass vessel partly exhausted of air by burning spirit. Dry cupping is easy to apply, but it is astonishing how few students know how to perform this simple operation neatly. They either fail to make the glass adhere or burn the patient with the spirit. Dry cupping applied freely all over the back is useful in bronchitis and pleurisy. It is one of the best methods of checking profuse hæmoptysis, and is used with advantage in lumbago and many forms of myalgia.

TRANSFUSION.

The idea of transfusion was familiar enough to ancient writers, but they lacked the requisite anatomical and

physiological knowledge to put their theories into execution.

There is a legend to the effect that transfusion was first performed on Pope Innocent VIII. It is said that his vital powers suddenly gave way, and he fell into somnolence so profound that the whole court believed him to be dead. All means of awakening his exhausted vitality having been resorted to in vain, a charlatan proposed transfusion by means of a new instrument of the blood of a young person. The blood of the decrepit old pontiff was passed into the veins of a youth, whose blood was transferred into those of the old man. The experiment was tried three days, and cost the lives of three boys, without saving that of the pope. This was in 1492.

In 1651 the idea was revived by a friar named Robert des Gabets, who seven years later gave a lecture on the subject at a conference held in Paris, but it does not appear that he ever practised the operation which he so enthusiastically advocated. About this time the subject attracted considerable attention, and Pepys, in his Diary, mentions that on November 14th, 1666, transfusion was performed experimentally at Gresham College on dogs.

In 1667 a French mathematician, named Denis, decided to perform transfusion on the human subject. For a long time he failed to find any one willing to submit to the operation; but at last he managed to get hold of a madman, who arrived in Paris, naked, and without means, and seized him as a fitting subject for the experiment. Eight ounces of calf's blood were transfused into his veins, and that night he slept well. The experiment was repeated on the following day, and the patient not only slept well, but woke up in his right mind.

Lower and King were emboldened to repeat the experiment in London. They found a healthy man willing to

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have some blood drawn from him and replaced by that of a sheep. As he felt the warm stream pouring in he declared that it was a delicious sensation, and that he would like to have the operation repeated. The tidings of the new discovery flew over Europe, and in Germany and Italy transfusion was many times performed with complete success, and it was confidently asserted that the new method of treatment would be universally adopted. These hopes, however, were soon dashed; the patient on whom Denis had operated again went mad, was again treated by transfusion, and died under the operation.

The son of the Swedish minister, who had been benefited by one transfusion perished after a second; and in April, 1668, the parliament of Paris made it criminal to attempt transfusion, except with the consent of the Faculty. Thus the whole treatment fell into discredit, to be revived once more in our own day on a scientific basis.

During the last twenty-five years transfusion, as a therapeutic agent, has advanced rapidly in favour, and is now generally recognized as a proceeding of great value. Innumerable treatises and papers have been written on the subject, and various instruments for simplifying—or complicating—the operation have been invented or described by various surgeons. Some recommend immediate transfusion, whilst others consider that the blood should be defibrinated before being injected. Most writers prefer venous infusion, but others have a leaning towards the arterial method. In all operations on the blood-vessels care would naturally be taken not to introduce air; but Oré assures us that a bubble or two of air is of no importance, and that the quantity to cause death must be considerable, a statement confirmed by the late Mr. Marcus Beck.

Many authors recommend that the blood, before being injected, should be diluted with some saline solution, such

as phosphate of soda, whilst others suggest that in the absence of blood an artificial substitute should be prepared. The following solution has been suggested :—

Chloride of sodium	1 dr.
Chloride of potassium	6 grs.
Phosphate of soda	3 grs.
Carbonate of soda	20 grs.
Distilled water	to 1 pt.

Many writers recommend the addition of a small quantity of alcohol, whilst others think that the introduction of any salt of potassium—presumably from its depressing action on the heart—is a mistake. In a recent case, sixteen ounces of the following solution were injected into a vein with good results :—

Chloride of sodium	50 grs.
Chloride of potassium	3 grs.
Sulphate of sodium	2½ grs.
Carbonate of sodium	2½ grs.
Absolute alcohol	2 drs.
Water at 100° F	20 ozs.

Coates has recorded a striking case in which the injection of twenty-two ounces of simple warm water into the median cephalic vein was attended with favourable results.

Some authors speak favourably of "auto-transfusion." By raising the legs and hips and compressing the abdomen, blood may be made to gravitate towards the heart and brain.

Attention has frequently been called to the value of milk as a substitute for blood in transfusion. Hodder, of Toronto, injected into the veins of three patients, suffering from Asiatic Cholera, fourteen ounces of milk without a bad symptom and with manifest advantage. Howe, of New York, injected six ounces of warm goat's milk into the

cephalic vein of a patient suffering from tuberculosis, whilst Gaillard Thomas injected eight and a half ounces of fresh cow's milk into the median basilic vein.

Another method of performing transfusion, is by injection into the peritoneal cavity. Ponfick injected into the abdomen of three patients, 250, 350 and 220 grammes respectively, of defibrinated blood. The results were favourable, and the slight feverishness and tenderness of the abdomen at first observed soon passed off.

COUNTER-IRRITATION.

By counter-irritation we understand the application of an irritant to the surface, with the view of diminishing or counteracting any morbid process which may be going on in any other part of the system. For example, if a man is suffering from synovitis and we paint his knee with iodine liniment, that is an example of counter-irritation. Many substances are employed as counter-irritants, the list including turpentine, ammonia, mustard, cajeput oil, and acetic acid. The most commonly employed counter-irritant is cantharides.

Blisters differ in their mode of action, according to the manner in which they are employed. The first effect of the application of cantharides is to produce tingling, smarting, and a sensation of heat. After that minute vesicles form, which soon coalesce so as to form blebs of various sizes. The primary action of a blister is to stimulate, but if the action is allowed to continue, the result is a depression of the bodily powers. It must be remembered that the serum contains a large proportion of albumin, and its abstraction is equivalent to bleeding the patient to the same amount.

Flying blisters are an excellent stimulant, and are of undoubted use in the asthenic condition, incidental to many

fevers. But it is essential that they should be flying blisters, and should be kept on only sufficiently long to redden the skin, and not long enough to induce the formation of a bleb. The blisters may be applied in quick succession to various parts of the body, such as the chest, the abdomen, the thighs, and the calves of the legs. Flying blisters do good in pneumonia, pleurisy, asthma, biliary, and renal colic, lumbago, and a great number of very different diseases.

When a blister has been allowed to remain on sufficiently long to form a bleb, the blister should not be cut. The skin forms a protective surface, and facilitates the healing of the subjacent surface. Moreover, if the blister is protected with cotton-wool so as to prevent its rupture, the serum is reabsorbed, and the risk of unduly weakening the patient is avoided.

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PHARMACOLOGY

OF

INORGANIC SUBSTANCES.

CHLORINE—CHLORINATED LIME—CHLORINATED SODA.

These substances have much the same action. They are antiseptics, deodorisers, and disinfectants. As antiseptics they arrest putrefaction, as deodorisers they prevent bad smells, whilst as disinfectants they destroy the specific poison of communicable diseases.

Chlorine gas has a great affinity for hydrogen, and in this way breaks up many chemical compounds. Being volatile it has a great advantage over charcoal.

A common method of disinfecting a sick room is to put a pound of chlorinated lime into a canvas bag and allow it to stand in a vessel containing a mixture of hydrochloric acid and water. A still better plan is to make a mixture of common salt, binoxide of manganese and sulphuric acid in a saucer. The chlorine generated is heavier than atmospheric air, so that the vessel must be placed on a shelf in the room and not on the floor.

When inhaled in a concentrated form chlorine excites spasm of the glottis and acts as an irritant to the mucous membranes of the respiratory passages. It may give rise to bronchitis or even pneumonia.

Freely diluted, it is useful as a disinfectant in cases attended with fœtid discharge from the bronchial tubes or a cavity in the lungs.

Chlorine acts as a bleaching agent by taking up the hydrogen of water and setting free nascent oxygen.

BROMINE.

Bromine is a liquid non-metallic element. It derives its name from βρωμος, a stench, a title conferred on it in honour of its disagreeable odour.

It is a disinfectant, but is rarely employed for this purpose, the peculiarity to which reference has been made militating against its general acceptance in that capacity.

It is sometimes inhaled in small quantities; but, being a powerful irritant, may excite bronchitis or pneumonia.

It is a caustic, and has been used as a local application to the os uteri.

Applied undiluted it destroys organic tissues forming a slough. In the American war it was largely used in the treatment of hospital gangrene.

It is recommended for nasal catarrh, hay fever, paroxysmal sneezing and diphtheria, but it is not extensively employed. Half a drachm may be mixed with four ounces of alcohol in a wide-mouth bottle and vaporized by the heat of the hand.

In the form of hypobromite of soda it is available for the estimation of urea, that substance being broken up into carbonic acid gas, nitrogen, and water.

THE BROMIDES.

There are three official bromides—the bromides of potassium, sodium, and ammonium. Certain effects are produced by the long continued use of the bromides to which the term "bromism" is applied.

The symptoms constituting bromism are:—

1. An eruption like acne which may go on to the formation of boils or even small ulcers. It is seen chiefly on the

face and back. The face at the same time presents a muddy or dusky hue.

2. Abolition of reflex action of the soft palate evidenced by absence of movement when the back of the throat is irritated. Although reflex irritability is lessened there is no true anæsthesia, the pain of an operation on the part being felt.

3. The intellectual faculties are blunted, the memory is impaired, the ideas are confused, the patient is dull, stupid, and apathetic, and has a constant desire to sleep.

4. The speech is slow and impaired, the tongue is tremulous, the body is infirm, the limbs are feeble, the gait is staggering, and the movements are inco-ordinated.

5. The sexual powers are impaired or even temporarily abolished.

6. There is general cachexia.

These symptoms are for the most part due to impairment of the functions of the spinal cord and brain. They soon disappear when the administration of the drug is discontinued.

The bromides are absorbed by the stomach and pass quickly into the circulation. In animals the bromides give rise to a diminution of reflex irritability and cutaneous sensibility, due in part to the effect of the drug on the cord, and in part to its influence on the sensory nerves. They contract the blood-vessels, including those of the brain, inducing anæmia of that organ. The potassium compound is more depressing than the ammonium, the ammonium more than the sodium.

Applied topically bromide of potassium impairs the contractibility of the voluntary muscles and destroys the functions of the motor nerves. It lessens the frequency and force of the heart's contractions, it shortens the stysole, and prolongs the diastole, finally arresting it in diastole.

The action on the heart is probably due to the potassium of the salt and not to the bromine.

The bromides are eliminated with the urine and traces may be detected within ten minutes of taking a dose; as excretion takes place slowly they may appear for some days after the drug has been discontinued. They may be detected in the milk, sweat, and saliva.

It is probable that the bromides, after being absorbed into the circulation, are partly eliminated by the mucous membrane of the stomach. This may be proved by a very simple experiment. Twenty grains of bromide of potassium are injected into the rectum, and, after a short interval, the stomach is washed out with the stomach-tube; on testing the fluid withdrawn from the stomach, it will be found to contain bromides. The recent researches of Kandidoff, have shown that many drugs such as iodide of potassium, hydrochlorate of quinine, salicylate of sodium, arsenic, and antipyrin, when introduced into the rectum, are discharged, at all events in part, by the mucous membrane of the stomach.

There can be no doubt as to the efficacy of bromide of potassium in the treament of many diseases, although it is worthy of note that it was omitted from the British Pharmacopœia in 1851, after having been introduced into the London Pharmacopœia in 1836.

It has been suggested that from the effect of the drug on the reflex action of the upper part of the pharynx, its local application might be useful in laryngoscopic examinations—practically, however, it is rarely used for this purpose, a preferable plan being to give the patient ice to suck.

It is found to be of value in the treatment of whooping-cough, and here again it is said to act by lessening the irritability of the larynx. It is only in uncomplicated cases of whooping-cough that it does good—in cases complicated

with bronchitis or teething, other remedies may be resorted to with greater expectation of benefit.

Many middle-aged women experience a difficulty in swallowing fluids, especially in public, the attempt to do so inducing an attack of choking. This condition is probably due to nervousness, and may be relieved by a systematic course of the bromides. A somewhat similar complaint is met with in children, and the same mode of treatment is indicated.

From the action of the drug on the cord its use is indicated in all kinds of convulsions. It is especially useful in epilepsy, in the convulsions of Bright's disease, in eclampsia, and in the convulsions of children, whether due to centric or excentric causes. In epilepsy it is our sheet anchor. There are few, if any, drugs which can be demonstrated to have a more beneficial action in the treatment of disease than that of the bromides in epilepsy. They do more good in the *grand mal* than in the *petit mal*.

Dr. Hughes Bennett made an inquiry into the action of the bromides in epilepsy, and arrived at the following conclusions:—In twelve per cent., omitting fractions, the attacks were completely arrested during the whole period of treatment, in eighty-three per cent. the attacks were greatly diminished, both in number and severity; in two per cent. the treatment had no apparent effect, and in two per cent. the number of attacks was augmented during the period of treatment. The bromides were equally efficacious whether the disease was inherited or acquired, whether complicated or not, whether recent or chronic, whether occurring in the young or in the old. The common practice in the treatment of epilepsy is to give the potassium salt alone, but better results are to be obtained by a combination of all three bromides.

One of the great difficulties in the prolonged administration

of the bromides in epilepsy is that they produce acne of the face. Women naturally object to be made "spotty" even when they derive benefit in other ways. Relief from this symptom may sometimes be obtained by ringing the changes on the different salts, but in many patients they all produce a rash. The addition of half a drachm of aromatic spirits of ammonia to each dose of bromide of potassium is often recommended; but this is not always successful, and probably it simply converts the bromide of potassium into bromide of ammonium. The addition of a couple of drops of the liquor arsenicalis to each dose sometimes proves efficacious; but we have still to find a thoroughly satisfactory bromide for epileptics.

In the diseases incidental to teething the bromides may often be given with advantage.

The bromides are useful as soporifics—they are good in the sleeplessness of acute illnesses, and the sleeplessness due to worry, overwork, grief, or dyspepsia. They are commonly given in combination with other narcotics, often with belladonna and hyoscyamus.

In the restlessness from which business men frequently suffer, and the irritability often experienced by women, as the result of over attention to their household duties, the bromides are the best remedies. Women say that bromide of potassium is to them what tobacco is to men.

In the heats and flushes from which many women suffer about the time of the menopause, the bromides are of the greatest possible value. They also control the restlessness and excitability from which many women suffer during pregnancy. In dysmenorrhœa and menorrhagia the administration of the bromides is attended with the best results.

In the treatment of hysteria the bromides will be found of the greatest value, and it is a good plan to give a mixture

of all three bromides. The same mode of treatment is useful in megrim or sick headache, and in some forms of neuralgia.

In the treatment of sea-sickness the bromides are of great value, but they must be given in large doses. The late Dr. George Beard, of New York, advocated the administration of single doses of from 100 to 120 grains of the mixed bromides in a tumbler of water. He says:—"In many cases large doses of bromides, say 100 to 120 grains, or even a larger amount, given in a tumbler of water, may be sufficient of itself, without any repetition in any quantity, to break up an attack of hysteria or sea-sickness, whereas the same case in the same condition, treated by divided doses of the same remedy, might not be affected at all."

In night screaming, nightmare, and somnambulism, the bromides yield excellent results.

In delirium tremens full doses of the bromides are well borne.

The bromides are just as efficacious as the iodides in eliminating lead from the system, a fact which, although not generally known, is vouched for by so good an authority as Professor Rutherford, of Edinburgh.

From the influence of the drug on the sexual system, the bromides may be given in full doses in the treatment of nymphomania and satyriasis.

There are few better remedies than the bromides for spermatorrhœa. Nearly all the concoctions so largely advertised in the daily press for this affection contain one or more of the bromides. The directions which accompany these nostrums are probably not without value. It is generally said that while the patient is taking the medicine he should sleep on a hard bed with little bed clothes, his hours of sleep are to be strictly limited, and he should get up at once when called in the morning. A cold bath is to

be taken daily, and the patient is to bathe his testicles in cold water every night when going to bed, although this latter plan has been accused of a tendency to excite a reactive hyperæmia of the parts which is prejudicial to their physiological repose. He should take little stimulants, and no grog at bedtime. He must be careful in the choice of literature, and especially should avoid reading quack works. He should take plenty of exercise, go in for cricket, football, or join a gymnasium or the volunteers. A commonly recommended auxiliary mode of treatment is to tie a reel round the loins, so that if the patient lies on the back he is uncomfortable, and turns over on to the side, it being found that wet dreams occur more commonly in the supine position.

Bromide of potassium has been given in the treatment of tetanus, usually in large doses, and sometimes in combination with physostigma.

In strychnine poisoning, half an ounce of bromide of potassium should be given to begin with, and this should be followed by drachm doses every ten minutes, either with or without chloral.

The dose of bromide of potassium, or sodium, or ammonium, is usually said to be from 15 to 20 grains, but it is often prescribed in very much larger doses. From 40 to 60 grains three times a day may be given for a day or two without producing inconvenience, and there is no doubt that in many cases very large doses of bromides may be given for very long periods without the production of untoward effects.

Dr. Hughes Bennett has recorded several cases in which patients have taken a drachm and a half of bromide of potassium daily for six years without inconvenience. He mentions the case of a man, æt. 30, who suffered from epilepsy from infancy, and who for five years took four drachms and a half of the bromides daily, *i.e.* during that

time he consumed upwards of 80 lbs. of the drug. He also points out that in many cases, while the beneficial action of the drug remained, their deleterious effects steadily diminished as long as the drug was taken. The most marked effects of bromism usually appear at the beginning of the treatment, and the eruption and physical and mental depression disappear, although the administration of the medicine is continued.

Bromide of potassium is commonly given in a mixture flavoured either with spirit of chloroform or syrup of orange.

A good formula is bromide of potassium twenty grains, syrup of Virginian prune one drachm, and water to an ounce, three times a day.

The elixoid of bromide of potassium now frequently prescribed, is palatable, and the tabloids containing five grains in each are convenient for administration. The bromide of sodium, as already pointed out, can be advantageously given in place of common salt and taken with food.

The following was Brown-Sequard's favourite prescription for epilepsy:—

℞	Potassii iodidi	ʒi.
	Potassii bromidi	℥i.
	Ammonii bromidi	ʒiiss.
	Potassii bicarbonatis	gr. xl.
	Infus. calumbæ	ad ℥vi.

M.—A tea-spoonful before each meal, and three tea-spoonfuls at bedtime, with a little water.

It is a good example of a prescription containing all three bromides. The dose of the combined bromides actually taken by the patient is a little bit doubtful, as teaspoons vary much in size, but it was probably from fifteen to twenty grains before meals and about a drachm at bedtime. It would have been better to have said, "twice

a day," or "three times a day," before meals, unless verbal directions were given to the patient as to the number of meals to be eaten. Mixtures containing bromides are usually given after meals, but this was probably ordered to be taken before meals for the sake of the tonic effect of the calumba. The dose of infusion of calumba is very small, and it might have been better to have substituted the tincture of calumba with some spirits of chloroform.

There are some other bromides which are occasionally prescribed.

Bromide of strontium can now be obtained in a sufficient state of purity for medicinal use. It is freely soluble in water, and is usually given in doses of from twenty to twenty-five grains three times a day. It is claimed for it that it never produces a rash on the skin, but on several occasions I have known it bring out a well marked acne. It is, however, a useful salt, and it is not unlikely that it will come into more extensive use.

Bromide of lithium is a white granular salt, very deliquescent, odourless, and possessing a sharp, somewhat bitter taste. It contains twice as much bromine as the potassium salt. Its use is advocated by Dr. Weir Mitchell, who claims for it that it is more hypnotic than the other bromides. It is said to be useful in calming the irritability of gouty patients. The dose is from 15 to 20 grains.

Bromide of zinc is very deliquescent, so deliquescent, in fact, that it has to be kept in small glass stoppered phials. Both bromine and zinc are used in the treatment of epilepsy, and it was thought that the combination might prove doubly efficacious. Unfortunately in large doses it acts as an irritant poison.

Dr. Hammond uses a syrup of bromide of zinc, made by dissolving 480 grains in 4 fluid ounces of syrup. The dose of this is 10 drops three times a day, increased to 40 drops

four times a day. The ordinary dose is from 3 to 10 grains well diluted.

Bromide of manganese, which contains 75 per cent. of bromine, has also been used. There are three objections to it: first, it causes a headache even in doses of a few grains; secondly, it is so bitter that when added to a bromide combination it gives an unpleasant taste to the whole mixture; and, finally, it has no special advantage over the other bromides.

IODINE.

Iodine crystals at first sight are not altogether unlike black lead. They consist chiefly of scales or plates having a shiny metallic appearance. They have a characteristic irritating pungent odour. When the bottle containing them has been standing in the sun the upper part contains a little violet vapour.

The name iodine is derived from ιωδης, "violet," in reference to the violet fumes given off when the iodine is heated. Iodine is but slightly soluble in water, but dissolves readily in spirit. One of the best solvents is a solution of iodide of potassium.

The official preparations of iodine are:—

1. Linimentum iodi, liniment of iodine.
2. Liquor iodi, solution of iodine.
3. Tinctura iodi, tincture of iodine.
4. Unguentum iodi, ointment of iodine.
5. Vapour iodi, inhalation of iodine.

There are several points to notice about these preparations. The linimentum is the strongest, its strength being about 1 in 9, whilst the tincture is only 1 in 40.

The liniment, the liquor and the tincture, and even the

ointment contain iodide of potassium, which is used for dissolving the iodine.

The mode of preparation of the vapour is peculiar; it is made not from iodine, but from the tincture. The tincture is added to the water, slightly heated, and the vapour inhaled.

The liniment and the tincture should be made with rectified spirit as directed in the Pharmacopœia. In hospitals methylated spirit is sometimes substituted from motives of economy, but the vapour is then extremely irritating to the eyes.

The liniment should be painted on the skin with a brush, and should never be rubbed in with the hand as other liniments are.

The so-called colourless iodine is made by adding strong solution of ammonia to the tincture of iodine and leaving it in a warm place until it has lost its colour. It is true it does not stain the skin, but it is equally true that it does not produce anything like the same effect as tincture of iodine as a counter-irritant. It is probably not extensively used.

When applied to the skin in the form of a solution, iodine produces a yellowish brown discoloration followed by a sensation of warmth and itching. When the solution is strong it causes pain, and the application may produce desquamation or even vesication.

Iodine in addition to being rubefacient is counter-irritant and promotes absorption. The liniment and tincture are often painted on the chest and on enlarged joints, so that the effects are readily observed. It must be remembered that the linimentum is by far the strongest preparation, and a single coat applied with a brush is usually sufficient. Should the application give rise to much pain the iodine may be removed by any spirit, such as gin, whisky, brandy,

or eau de Cologne, but a saturated solution of iodide of potassium is still better. A linseed poultice usually eases the pain, but a hypodermic injection of morphine may be required to give complete relief.

Tincture of iodine applied locally acts as a parasiticide, and is used in ringworm to destroy the fungus. A useful application for this purpose is Coster's paint, which is made by adding, with the application of heat if necessary, two drachms of iodine to an ounce of light oil of wood tar.

Taken internally, in the form of tincture, iodine acts as an irritant to the stomach and intestines, giving rise to catarrh of the mucous membrane.

The constitutional symptoms resulting from the administration of iodine are best considered when speaking of the iodides.

Iodine in the form of the liniment or tincture is painted over the chest and back to promote absorption of fluid in cases of chronic plurisy.

Painted under and above the clavicles it allays the cough of phthisis.

Painted all over the back and chest it is useful in bronchial catarrh and chronic bronchitis.

Applied to the joints it relieves the pain of gout, rheumatism, and chronic synovitis.

If the liniment produces too much pain it may be mixed with an equal quantity of tincture.

The ointment being the weaker preparation is well adapted for children.

The ointment is a useful application for chilblains before they are broken.

The inhalation of iodine is useful in fibroid phthisis, especially when the expectoration is abundant and the cough is troublesome. The vapour may be prepared by adding ten drops of tincture of iodine to a pint of hot water at

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135° F. and inhaling the steam. A stronger preparation is often used, but this answers well.

Ten drops of tincture of iodine in a wine-glass of water is one of the best remedies for sea-sickness.

A mixture of equal parts of tincture of iodine and tincture of aconite painted on the gums night and morning removes tartar from the teeth, and is an excellent application for spongy gums and for gums which recede from the teeth.

THE IODIDES.

There are two official iodides, the iodides of potassium and sodium. The iodide of ammonium is not official. Why there should be three bromides and only two official iodides has not yet been discovered. The red iodide of mercury and some other iodides are used, not for the sake of the iodine, but for the action of the base, and, although chemically iodides, are not considered from that point of view by the pharmacologist. The iodide of lead is used in the preparation of the plaster and ointment of iodide of lead. Applied externally they act as mild irritants, and are useful in the treatment of chronically inflamed joints.

There are two preparations of iodide of potassium :—

1. Unguentum potassii iodidi.
2. Linimentum potassii iodidi.

They are both useful preparations, although comparatively rarely employed.

When the iodides are given for a length of time they may produce a train of symptoms to which we apply the term "iodism." Iodism is entirely and essentially different from bromism. The following are the symptoms which constitute iodism :—

1. Running at the eyes and nose, sneezing, frontal headache, injection of the conjunctivæ, an abundant flow of

tears, with a swollen, reddened and œdematous condition of the tissues about the orbit, together with smarting and tingling of the parts.

2. A rash not infrequently appears over the whole body. This may be acne, or may assume a petechial form. It often begins in the region of the nose, and then extends to the chin, the nose at the same time being reddened and swollen at the tip. The skin eruptions due to the iodides are sometimes developed after one or two doses. They vary much in character, and, in addition to acne and petechial forms, erythemata, vesicular, and bullous eruptions may occur, some of them resembling syphilitic eruptions. If the drug is pushed, the condition may be aggravated and in one instance death resulted. The liquor arsenicalis is said to have some power in controlling their appearance, but idiosyncrasy has much to do with it.

3. In some cases these symptoms are absent, but there is gastric disturbance, the patient suffering from nausea, sinking at the pit of the stomach, loss of appetite, and watery diarrhœa.

4. Sometimes all these symptoms are absent, but the patient experiences intense depression, both of mind and body; he is irritable, dejected, listless, wretched, and fit for nothing.

Some patients are so exceptionally susceptible to the action of iodine that a single grain of iodide of potassium or sodium will produce some or all of these symptoms. Sometimes a patient will take one salt of iodine without difficulty when another disagrees. The aromatic spirits of ammonia, added to an iodide of potassium mixture, is said to prevent the occurrence of iodism. It probably acts by converting the potassium into an ammonium salt. Syrup of iodide of iron has been known to produce iodism. Clarke's "Blood Mixture" consists of iodide of potassium, forty-eight grains,

chloric ether, four drachms, solution of potash, half a drachm, and water coloured with burnt sugar to eight ounces. Cases of iodism from its administration must be of common occurrence.

The iodides, when taken into the stomach, are very rapidly absorbed. It is probable that in the blood all iodides form combinations with common salt, and act as iodide of sodium. It is possible, however, that the iodine may be set free, and may enter into combination with albuminous substances. This may throw some light on its mode of action in promoting the absorption of gummatous and other growths. The entrance of a molecule of iodine into the composition of the albuminous material may favour its metamorphosis and disintegration. Lead and mercury are set free from the tissues by iodine, and are rapidly eliminated. It is said that the iodides sometimes cause salivation, but this is only indirectly true. They give rise to salivation only in those who have previously taken mercury. The mercury has been deposited in the form of an albuminate, and on the administration of an iodide it is brought once more into the circulation, and produces its constitutional effects.

The iodides are eliminated by the kidneys, and may be detected in the urine a few minutes after a dose has been taken. The iodine has been detected in the blood, the saliva, the urine of sucking children, and in most of the secretions. Probably some of the iodine is eliminated by the skin, and causes the rash. A popular method of demonstrating the presence of iodine in the saliva is to put a bright shilling in the mouth for a few minutes, when it rapidly becomes discoloured.

The iodides are of the greatest possible value in what is commonly called tertiary syphilis, in the treatment, that is, of those symptoms which sometimes appear many years

after a patient has had an attack of syphilis. They may assume various forms, and, for a time, their nature may not be recognized. The patient may suffer from chronic and relapsing periostitis, from muscular pains, nodes, or gummata in the substance of the muscles, from diseases of the skin of a lupoid type, from locomotor ataxy, from paralysis of certain special nerves, such as the fifth or the facial, or from symptoms of commencing general paralysis. In all these cases the iodides do good. It is probably not a matter of any particular importance which of the salts is given, but the sodium salt produces less depression than the potassium salt. A good many authorities give all three iodides, potassium, sodium, and ammonium, together, and some think that the addition of half a drachm of sal volatile to each dose is a decided advantage. It is probably best to begin with a small dose of the iodides, say three to five grains, three times a day after meals, and gradually to increase it to ten or even twenty grains three times a day. A favourite combination with surgeons is a mixture containing one-sixteenth of a grain of perchloride of mercury, five grains of iodide of potassium, half a drachm of sal volatile, and fifteen minims of spirit of chloroform, in an ounce of water.

The iodides are also indicated in rheumatic and gouty conditions. They are especially indicated when the pains are "worse at night."

The iodides are of great value in the treatment of saturnine gout, that is to say, gout resulting from chronic lead poisoning. Patients who find that iodide of potassium depresses them should take iodide of sodium. The iodine combines with the lead and the sodium with the uric acid. Most people can take five grains of iodide of sodium and ten minims of colchicum wine three times a day without inconvenience.

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The risk of producing absorption or atrophy of the mammæ or testicles from the prolonged use of the iodides is very small, but at the same time it must be admitted that permanent depression of the sexual function may occur. It has been pointed out that certain "blood purifiers" contain large doses of iodide of potassium, and it would probably lead to a very interesting discussion in the event of a patient, who had taken one of these combinations, claiming damages for the loss of his virile power from the action of the iodide of potassium.

SULPHUR.

There are two kinds of sulphur used in medicine:—

1. Sulphur Sublimatum, sublimed sulphur, flowers of sulphur.
2. Sulphur Præcipitatum, precipitated sulphur, lac sulphuris, milk of sulphur.

Stick sulphur is not used in medicine.

Sublimed Sulphur is a bright yellow gritty powder, without taste or smell. It is volatile, insoluble in water, soluble in hot oil of turpentine, and in fixed oils, such as olive oil. There was formerly a preparation known as "balsam of sulphur," made by dissolving sulphur in oil.

Precipitated Sulphur has the same physical characters as sublimed sulphur, with the exception that it is lighter in colour, in consequence of its finer state of subdivision—being made by precipitation—and that it is not gritty. There is no difficulty in distinguishing sublimed from precipitated sulphur. By daylight the colour is the best test, sublimed sulphur being of a citron or bright yellow colour, whilst precipitated sulphur is pale yellow. By gaslight it is difficult to distinguish colours, and then the consistency is the best guide, sublimed sulphur being

gritty, whilst the precipitated, from its more minute state of subdivision, is quite smooth. When precipitated sulphur is improperly prepared with sulphuric instead of hydrochloric acid, it contains crystals of sulphate of lime, which are readily detected under the microscope. Sublimed sulphur never contains these crystals.

There are two official preparations of sublimed sulphur:—

1. Confectio sulphuris or confection of sulphur containing sulphur, acid tartrate of potassium, syrup of orange-peel, and tragacanth.

2. Unguentum sulphuris or sulphur ointment made with benzoated lard.

Sublimed sulphur is also contained in the compound liquorice powder.

There is one official preparation of precipitated sulphur:—

1. Trochisci sulphuris or sulphur lozenges. These are sometimes known as Garrod's lozenges, from their recommendation by Sir Alfred Garrod, in 1889, in the treatment of certain chronic affections of the alimentary canal, liver, skin, and joints. They are composed of precipitated sulphur, acid tartrate of potassium, refined sugar, gum acacia, tincture of orange peel and mucilage of acacia. Each lozenge contains five grains of the sulphur with one grain of acid tartrate of potassium, and the dose is from one to six lozenges. The usual plan is to prescribe one lozenge at night, sometimes two, and sometimes one night and morning.

The acid tartrate of potassium is added to the confection and lozenges to increase their purgative action.

Common lard is not used in making the ointment, as it becomes rancid and acts as an irritant to the skin. Benzoated lard contains benzoin, which being antiseptic, prevents the lard from undergoing change.

A confection or electuary is a thick semi-solid sticky

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substance usually made with honey or sugar, the dose being a tea-spoonful. Sulphur could not be readily given in a fluid form on account of its insolubility, and it could not be prescribed as a pill because the dose is too large. Another good example of a confection, is the confection of senna, which is often given with confection of sulphur as a laxative. Such substances as iodide of potassium or bromide of potassium are not given as confections, because they are readily soluble in water. Calomel, although insoluble, is not prescribed as a confection because it is an active drug and accuracy of dose is essential. As a rule there are confections of drugs which are insoluble, the dose of which is large, and which are not very active. Some confections, such as the confection of roses, are used simply as vehicles for the administration of other drugs.

Sulphur is a laxative. A laxative is the mildest form of purgative, increasing only slightly the action of the bowels, and not producing watery motions. Other examples of laxatives are figs, prunes, honey, treacle, manna, tamarinds, and magnesia. Oatmeal, brown bread, bran biscuits, and many fruits are also laxative, some of them producing their effect by the stimulation of the peristaltic action caused by the presence of small seeds or other indigestible particles. Sulphur has little action on the secretions, but purges by stimulating the involuntary muscular tissue to increased contraction. It produces soft semi-solid motions, so that it is used, not only in constipation, but in piles, fissure of the anus, and stricture of the rectum. The compound liquorice powder contains sulphur, senna, liquorice, and fennel, and is a useful preparation.

Sulphur is anti-parisiticide, and in the form of the ointment is largely used in the treatment of itch. It is often maintained that the sulphur plays no part in the destruction of the acarus, but that the fat by obstructing the breathing

pores suffocates and so destroys it. This view is untenable, for sulphur ointment is much more effectual than simple lard. It is probable that sulphuretted hydrogen is formed, and being a powerful toxic agent, destroys the itch insect.

Sulphur is a mild expectorant, being used for this purpose in cases of old-standing bronchitis.

Respecting the changes which sulphur undergoes in the body, very little is known. When brought in contact with living protoplasm it probably enters into combination and forms sulphurous acid or sulphuretted hydrogen. It is eliminated partly with the fæces in form of sulphides, partly by the urine in the form of sulphates, and partly by the skin, breath, and intestines as sulphuretted hydrogen. The breath of patients taking sulphur smells of sulphuretted hydrogen, and articles of silver worn as ornaments turn black.

The fumes of sulphur are employed with advantage for disinfecting sick-rooms after the occurrence of scarlet fever, diphtheria, and other contagious diseases. The windows, doors, and other apertures are carefully closed, and metallic articles, such as the fender and fire-irons, are removed or covered with grease. Stick-sulphur is then placed in an old metal vessel, such as a disused saucepan, and covered with methylated spirit which is then lighted. It is a good plan to support the pot on a pair of tongs placed over a pail containing water in case the apparatus should upset. When the sulphur is well alight the room should be left closed for some hours, after which it should be exposed to a thorough draught of fresh air from the open door and windows for a couple of days or more.

Sulphur is frequently employed externally in the form of a poultice in chronic rheumatism and chronically inflamed joints. The poultice should be made in the same way as a linseed meal poultice, equal parts of linseed meal and

precipitated sulphur being employed. Some people make the poultice first of linseed meal and then spread the sulphur on the surface.

It is a common custom in cases of rheumatism, sciatica, and lumbago to freely dust the inside of the stockings and drawers with sulphur, and the same treatment is frequently resorted to in chronic skin diseases such as eczema and psoriasis.

The following is a useful formula for an ointment in cases of scabies:—

Sulphur	½ dr.
White precipitate	4 grs.
Creasote	4 drops.
Oil of chamomile	10 „
Lanoline ointment	1 oz.

It should be rubbed in night and morning especially between the fingers. On the fourth day a hot bath is taken and the linen is changed.

For acne of the face, especially in that form which occurs commonly in young women, a sulphur lotion will be found useful.

Sulphur Lotion.

Precipitated sulphur	1 dr.
Glycerine	1 oz.
Elder flower water	6 ozs.
Rose water	to ½ pint.

This lotion, after being well shaken, should be applied freely to the face, the superfluous sulphur being dusted off with a soft handkerchief.

Another good application for acne is—

Compound Sulphur Powder.

Precipitated sulphur	... ...	½ oz.
Sulphate of lime	... ...	½ oz.
Phosphate of lime	... ...	½ oz.
Heliotropin	... ...	5 grs.

The powder mixed with a little water is applied first to all the inflamed and painful pustules, whilst other portions of the face affected with acne are simply dusted over with the powder without the addition of water. A cure is usually effected in a few days.

For internal use the usual dose of sulphur is from thirty to sixty grains, but more may be given. It may be administered in milk, or in the form of the confection or lozenges. The old-fashioned remedy, brimstone and treacle, or sulphur and molasses, is well known. Sulphur in all forms is useful in chronic constipation, and is frequently employed to ensure a copious and easy evacuation in cases of piles, fissure of the anus, and fistula.

SULPHUROUS ACID.

Acidum sulphurosum or sulphurous acid is, according to the Pharmacopœia, sulphurous acid gas dissolved in water and constituting five per cent. of the solution.

It is a colourless liquid, having a powerful odour of burning sulphur. When evaporated it leaves no residue.

It is a deodorizer and a disinfectant. It arrests putrefaction and also fermentation by destroying the organisms on which the process depends.

Sulphurous acid is a parasiticide, and sulphurous acid baths are frequently used in the treatment of scabies.

In chloasma or tinea versicolour, a parasitic skin disease depending on the presence of a fungus known as *Microsporon*

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furfur, the sulphurous acid solution is used, mixed with an equal quantity of water or glycerine, as a local application. The skin should first be washed with soap to get rid of the greasy condition it often presents, and then dabbed over freely with aromatic vinegar to neutralize the alkali of the soap, after which a few applications of the lotion will speedily destroy the parasite. It is recommended in the treatment of tinea tonsurans, or ringworm, but fails to give satisfactory results unless a saturated solution of sulphurous acid in glycerine is substituted for the official solution. It is used for chilblains and chapped hands, and in the form of a spray is useful in many throat affections and in some forms of chronic bronchitis and phthisis, especially when the expectoration is offensive. It is antiseptic, and is given to check fermentation in the treatment of pyrosis or water-brash and in flatulence.

The sulphites are not used in medicine, but the hyposulphite of soda is a valuable drug. Its uses are practically identical with those of sulphurous acid, it being simply sulphurous acid in combination with a base. It was at one time recommended as a remedy for phthisis, but its use is now confined almost exclusively to the treatment of flatulence. The dose is from ten to sixty grains, and it may be conveniently given in any aromatic water.

A solution of hyposulphite of soda may be used for removing iodine stains from the hands, the strength of the solution being a drachm to the ounce.

THE SULPHIDES.

The sulphides are valuable remedies. Sulphurated potash is known as "Hepar sulphuris," or liver of sulphur, whilst sulphide of calcium is "Hepar calcis," or liver of lime.

For baths the sulphurated potash is commonly employed, the proper strength, according to Dr. C. D. F. Phillips, being half a pound to thirty gallons of water. These baths are useful in many chronic skin diseases, especially eczema and psoriasis, but they should not be used in the acute stage. They are also prescribed in the treatment of itch, chronic gout, chronic rheumatism, chronic rheumatoid arthritis, and chronic lead poisoning.

Many natural waters contain the sulphides, as for example, Harrowgate and Strathpeffer in this country, Barèges in the Pyrenees, and the Blue Lick Springs of Kentucky.

For internal administration the sulphide of calcium is the favourite salt. It is a dirty white powder having a disagreeable taste and a marked sulphuretted odour. It is partly decomposed by the acid of the stomach, so that patients taking it complain of disagreeable eructations of sulphuretted-hydrogen gas.

It is used in the treatment of boils and carbuncles, a tenth of a grain tabloid or pilule being taken every three hours, or even every hour. It will check the formation of pus in the early stage, or if given later will promote its discharge and conduct the process to a favourable termination.

It is also useful in the treatment of acne and of enlarged glands of the neck, especially in scrofulous children.

It is recommended in scrofulous sores and in diseased bones in scrofulous subjects.

It is useful in abscess of the breast, and in fact in all kinds of chronic abscesses.

The sulphide of calcium is a powerful toxic agent and cannot be given in unlimited quantities. It is safe to give half a grain at a dose, but it is better to give a tenth of a grain in the form of a pilule every three hours. It is

an excellent remedy, and one on which the greatest reliance can be placed.

PHOSPHORUS.

There are two kinds of phosphorus—the white or stick phosphorus which is official, and the amorphous phosphorus which is unofficial. The white variety is soluble in ether, oils, naphtha, and bisulphide of carbon, whilst the red is insoluble in bisulphide of carbon. The stick phosphorus is a powerful medicinal substance, but the red variety is inert, and has been given in half-drachm doses three times a day for forty days without producing any symptom.

There are two preparations of the official phosphorus:—

1. Oleum phosphoratum or phosphorated oil, a solution of phosphorus in oil of almonds.

2. Pilula phosphori or phosphorus pill made with wax, soap, and other substances. The pharmacopœial pill is absolutely insoluble, and is never prescribed.

The oil is a one per cent. solution, whilst a thirtieth of a grain of phosphorus is contained in three grains of the pill.

Soluble phosphorous pills can be made with cocoa-butter.

Phosphorus is sometimes given in capsules, and a solution in ether is by no means a bad form.

The following formulæ are recommended by the British Pharmaceutical Conference:—

TINCTURA PHOSPHORI COMPOSITA.

Phosphorus	12 grs.
Chloroform	$2\frac{1}{2}$ fluid ozs.

Place in a stoppered bottle, and apply the heat of a water-bath until dissolved. Then add the solution to

Absolute Alcohol	$12\frac{1}{2}$ fluid ozs.

Shake well. This tincture should be preserved from the light, in accurately stoppered bottles. It deteriorates if long kept.

Each fluid drachm contains $\frac{1}{10}$ grain of phosphorus, and the dose is from 3 to 12 minims.

ELIXIR PHOSPHORI.

Compound Tincture of Phosphorus ...	4 fluid ozs.
Glycerine	16 „

Add the tincture to the glycerine, and shake well. This elixir should be freshly prepared and preserved from the light in full bottles. Each fluid drachm contains $\frac{1}{50}$ grain of phosphorus, and the dose is from 15 minims to 1 fluid drachm.

When phosphorus is given to animals for a long time the condition of the bones becomes altered in a remarkable way. Where spongy bone should be formed dense osseous tissue takes its place. In chickens fed on food containing phosphorus the bones frequently become solid like sticks. The bone deposited is very dense, so that the Haversian canals are obliterated. The deposit does not result from an excess of phosphates in the blood, but is the result of stimulation by the phosphorus itself of tissue-growth.

Workmen exposed to the fumes of phosphorus in match manufactories are liable to necrosis of the jaw. This is due to the direct action of the phosphorus on the bare bone, and does not occur unless the patient has either bad teeth or a wound or sore about the mouth. This condition does not result from the internal administration of phosphorus. The complaint was at one time common in lucifer-match manufactories, the "dippers," or people who dip the slips of wood in the inflammable composition, being the chief sufferers. The disease, in consequence of the introduction

[redacted]

of safety matches made with red phosphorus, is far less common than formerly.

Phosphorus given internally may, by its stimulating and irritating action, cause excessive development of the fibrous tissue of the liver. If its administration be continued it may give rise to fatty degeneration of the stomach, liver, kidneys, heart and voluntary muscles. This process of degeneration is due to a rapid splitting up of all albuminous tissues with deficient oxidation, and takes place even when fatty food is not administered.

When given in large doses, phosphorus produces a burning sensation in the throat, with intense thirst and pain in the stomach, followed by distension of the abdomen and vomiting of a dark green or black substance, having the odour of garlic and presenting a phosphorescent appearance in the dark. The patient exhibits symptoms of collapse, and in the course of a few hours, or perhaps days, there may be noticed tenderness over the liver, jaundice, diarrhœa, and scanty albuminous urine containing blood. There are usually extensive subcutaneous hæmorrhages with an eruption on the skin of petechial spots. It has been found that wounds or sores bleed profusely, and post-mortem the tissues are seen to be in a condition of fatty degeneration. The liver may be enlarged, with its cells in a state of advanced fatty degeneration, or it may be contracted from destruction of its cells. The fatty degeneration affects the whole of the arterial system, and involves even the smallest arterioles. The jaundice is probably due to catarrh of the small biliary ducts causing obstruction and leading to absorption of the bile.

Very marked effects are said in some cases to follow the administration of ordinary doses of phosphorus. There is an improvement in the appetite, a quickened pulse, a heightened temperature, a copious secretion of urine loaded

with lithates, a sharpening of the mental faculties, an increase in muscular power, a general sense of well-being, together with some increase in sexual appetite. These symptoms are not of constant occurrence, and undoubtedly in very many people are never experienced.

Under the influence of phosphorus the excretion of urea is diminished and the products of nitrogenous disintegration appear in the urine as leucin or tyrosin. Phosphorus in some cases gives the urine a smell of violets.

Phosphorus therapeutically is employed chiefly in the treatment of impotence resulting from what is commonly called nervous exhaustion.

There are many pills which are employed in this condition, and the following are suggested as useful formulæ:—

1.	Phosphorus	$\frac{1}{50}$ gr.
	Strychnine	$\frac{1}{30}$ gr.
	Dried sulphate of iron	2 grs.
	Extract of aloes	1 gr.
2.	Phosphorus	$\frac{1}{50}$ gr.
	Reduced iron	3 grs.
	Strychnine	$\frac{1}{30}$ gr.
	Sulphate of quinine	1 gr.
3.	Phosphorus	$\frac{1}{33}$ gr.
	Extract of nux vomica	$\frac{1}{8}$ gr.
	Extract of damiana	3 grs.

Phosphorus is allied in physiological action to vanadium, the salts of which produce fatty degeneration of the liver.

THE PHOSPHATES.

Phosphate of calcium may be taken as a type of the phosphates. It is a white, tasteless, odourless powder, quite insoluble in water. Its action is due partly to the lime it

[redacted]

contains, and partly to the phosphorus. It is an important constituent of the body, and plays an active part in the formation of bone and in giving solidity to the skeleton. It forms the first basis of new tissues, and where cell growth is active it is always found in increased quantity. In animals, fractured bones unite more speedily when phosphate of lime is administered. It is useless to give it in large quantities, for its diffusion power is small. It is probably acted on by the acids of the stomach, but much of it passes unaltered into the intestines, and some of it is eliminated with the fæces.

Phosphate of lime is useful in the anæmia of young and rapidly growing girls, and is especially indicated in the case of women weakened by child-bearing, prolonged suckling, or excessive menstruation. The following is a good formula:—

Phosphate of lime	1 gr.
Phosphate of iron	1 gr.
Saccharated carbonate of iron	1 gr.
Sugar of milk	2 grs.

To make a powder. One to be taken three times a day after meals.

THE HYPOPHOSPHITES.

The official hypophosphites are the hypophosphites of lime and sodium. When heated to redness they ignite, evolving spontaneously inflammable phosphuretted hydrogen. They hold their phosphorus in weak chemical combination, and therapeutically present some of the properties of that drug. They are undoubtedly of much value as therapeutic agents, especially in the treatment of consumption, but respecting their pharmacological action it is difficult to meet with trustworthy data.

Fellow's syrup of the hypophosphites contains the hypophosphites of iron, lime, manganese, and potassium, with in each drachm three-quarters of a grain of quinine and one sixty-fourth of a grain of strychnine.

The following formulæ have been adopted by the British Pharmaceutical Conference:—

LIQUOR HYPOPHOSPHITUM COMPOSITUS.

Hypophosphite of calcium	320 grs.
Hypophosphite of sodium	320 „
Hypophosphite of magnesium ...	160 „
Strong solution of hypophosphite of iron	6 fluid ozs.
Hypophosphorous acid, 30 per cent. ...	½ „ oz.
Distilled water, a sufficient quantity.	

Dissolve the hypophosphites of calcium, sodium, and magnesium in twelve fluid ounces of distilled water; add the solution of hypophosphite of iron and the hypophosphorous acid. Filter, and make up to one pint by the addition of distilled water.

Each fluid drachm contains 2 grains each of hypophosphite of sodium and calcium, 1 grain of hypophosphite of magnesium, and 1½ grains of hypophosphite of iron.

The dose is from ½ to 2 fluid drachms.

SYRUPUS HYPOPHOSPHITUM COMPOSITUS.

Quinine	20 grs.
Strychnine	1 gr.
Hypophosphorous acid, 30 per cent. ...	2 fluid drs.
Strong solution of hypophosphite of iron	3 fluid ozs.

Dissolve, and add

Hypophosphite of calcium	80 grs.
Hypophosphite of manganese ...	40 „
Hypophosphite of potassium	40 „

Dissolve, filter, and add

Syrup, sufficient to produce	1 pint.

Mix. Each fluid drachm contains $\frac{1}{160}$ grain of strychnine and $\frac{1}{8}$ grain of quinine. The dose is from $\frac{1}{2}$ to 2 fluid drachms. This preparation will be found useful in the treatment of phthisis and as a tonic.

THE ACIDS.

The three acids—hydrochloric, sulphuric, and nitric—may be conveniently considered together.

There is one preparation of hydrochloric acid—the dilute acid.

There are two preparations of sulphuric acid—dilute sulphuric acid and aromatic sulphuric acid.

There are two preparations of nitric acid—dilute nitric acid and dilute nitro-hydrochloric acid.

The fumes of all these acids act injuriously on animal and vegetable life. In the neighbourhood of manufactories where carbonate of sodium is prepared from common salt, the vapour of the hydrochloric acid, if not condensed, destroys all vegetation for miles round. The same thing occurs in the extraction of copper from pyrites, in the manufacture of common glass bottles, in brick and cement burning, and in some other trades. Cases are recorded where the air has been so fully impregnated with fumes as to induce spasm of the glottis in casual passers by. The destruction of animal and vegetable life by this means is a frequent cause of complaint, and often leads to litigation. By the "Alkali Act," manufacturers have to condense ninety-five per cent. of the gas which may be produced by the materials used, and there must not be more than a fifth of a grain of gas per cubic foot of air leaving the works.

All the members of the group have a strong affinity for alkalies; and some, such as sulphuric acid, absorb water with avidity. They have a high diffusion power, so that

they pass readily through animal membranes and textures. When applied to the skin they destroy the tissues to a considerable depth, penetrating until they are neutralized by the bases with which they come in contact.

Sulphuric acid possesses this power to a remarkable degree, and acts as an escharotic, destroying the tissue with which it comes in contact. Around the part destroyed inflammation ensues, and an eschar, or portion of dead tissue, separates. The dilute acids act as astringents and check hæmorrhage by constringing the blood-vessels and coagulating the blood.

Freely diluted and used as a bath nitro-hydrochloric acid is a rubefacient, and reddens the skin. The ordinary nitro-hydrochloric acid bath is made by adding a pound of nitric acid and a pound and a half of hydrochloric acid to thirty gallons of water. It is very often prescribed in cases of chronic jaundice, and in chronically enlarged livers. The fumes given off are apt to irritate the eyes and nose. This makes a very strong bath, and smaller quantities of the acids are often used. The sponge and towels should be left to soak in water containing carbonate of soda.

Given internally *acids check acid and promote alkaline secretions.* This is the key to their action. The saliva is alkaline, and acids promote its secretion—an explanation of the use of acid drinks in checking thirst. The gastric juice is acid, and an acid given before meals checks its excessive formation, and relieves acidity. Acids given after meals aid digestion, not by increasing the secretion of the gastric juice, but by rendering it more acid.

A consideration of the fact that weak alkaline solutions, such as the saliva, increase the secretion of the gastric juice, affords an explanation of the common experience that meals which are well cooked and are appetizing are easy of

digestion. The sight and smell of food make the mouth water, and as the saliva is swallowed the gastric juice is stimulated to increased secretion. We have also an explanation of the common use of vinegar, with the view of reducing obesity. The vinegar taken before meals checks the secretion of the gastric juice and prevents digestion and assimilation. A case is recorded of a lady who habitually took large doses of vinegar in this way, and ultimately died of emaciation.

Acids are for the most part absorbed by the stomach, passing into the blood, where they combine with bases, and set free weaker acids. Their action on the blood must be insufficient to affect its reaction, for tissues are nourished only by blood, which is either neutral or alkaline. In rabbits death may ensue from the abstraction of the alkalies of the blood, caused by the administration of large doses of acids.

Any acid which escapes into the intestine is neutralized by the biliary and pancreatic secretions. The bile being alkaline, its secretion would be promoted by the presence of an acid, and this may partly explain the action of acids in stimulating the liver and relieving that organ when congested. In the same way they promote the flow of the intestinal secretions. It is probable that acids as such never reach further than the duodenum. If absorbed from the duodenum, they must pass through the liver on their way to the blood, and may stimulate its tissues in the process.

Acids are usually eliminated by the kidneys in combination with ammonia, but if given in large doses they increase the acidity of the urine.

Acids, nitrohydrochloric acid, citric acid, and acetic acid, for example, diminish the excretion of urea, a fact which affords a ready explanation of the tendency of young and acid wines to produce gout.

Citric and tartaric acids have the same action as the mineral acids, but in a milder form. They are said to be refrigerant, although there is no definite evidence that they reduce the temperature.

Citric acid is used for making artificial lemon juice, the formula for which is —

Citric acid	210 grs.
Freshly prepared mucilage of acacia ...	3 drs.
Simple syrup	1 dr.
Distilled water	$5\frac{1}{2}$ ozs.

Hydrochloric acid is frequently prescribed in cases of dyspepsia.

Given after meals it is useful in cases of atonic dyspepsia, and helps digestion.

In cases of acidity where sour fluid regurgitates into the mouth and sets the teeth on edge, the dilute acid should be given before meals.

If given in ten or fifteen minum doses it can be made into a palatable mixture with spirit of chloroform, syrup of orange-peel, and tincture and infusion of gentian, calumba or chiretta.

Dilute sulphuric acid in conjunction with sulphate of magnesium, sulphate of sodium, and various aromatics, such as tincture of capsicum and peppermint water, is useful in lead poisoning by forming an insoluble salt in the intestines.

Dilute sulphuric acid is the stock remedy in most of our hospitals for summer diarrhœa. It is inferior to a saturated solution of camphor in alcohol, but as it is usually distributed by the surgery porter to all comers, it probably serves a useful purpose. It is usually given in the form of a mixture, the formula for which is as follows :—

Dilute sulphuric acid	2 drs.
Tincture of opium	1 dr.
Spirit of chloroform	$1\frac{1}{2}$ drs.
Water	to 8 ozs.

Dose, two tablespoonfuls.

It would not be difficult to improve this mixture without adding to the expense. In the first place, camphor water, or strong peppermint water, might be used instead of ordinary water, and tincture of capsicum would be a useful ingredient. The chloroform might be omitted, and treacle might be used as a flavouring agent.

BORACIC ACID.

Boracic Acid, or Boric Acid, is an antiseptic, disinfectant, and deodorant. It does not check the peptonizing action of the gastric juice or of the pancreatic secretion, nor does it arrest the conversion of starch into glucose. It checks putrefactive fermentation and prevents the conversion of alcohol into acetic acid. It produces little or no irritation of the tissues, a circumstance which renders it especially useful as a surgical dressing. The ointment is largely employed in the treatment of wounds, burns and some skin diseases such as eczema.

As a dusting powder it is useful in preventing the disagreeable odour arising from decomposing sweat. It rarely fails to effect a cure.

It is largely used to prevent milk from turning sour. The question has arisen as to whether this addition is harmful, and it has been suggested that small doses of boracic acid taken systematically, may prove injurious; but there is no evidence that it produces any prejudical effect on the animal economy. In large doses it would probably act as a gastro-intestinal irritant.

"Boroglyceride" is made by heating together ninety-two parts of glycerine and sixty-two parts of boracic acid. It is said to be a definite chemical compound. Its

solution in water is a powerful antiseptic, and will keep milk, fish, meat, and other articles of food almost indefinitely.

In the treatment of flatulence, due to acid fermentation, the following mixture will be found useful:—

Boroglyceride	$\frac{1}{2}$ dr.
Glycerine	$\frac{1}{2}$ dr.
Spirit of chloroform	15 mins.
Syrup of lemon	$\frac{1}{2}$ dr.
Water	to 1 oz.

Borax, the biborate of sodium, is a powerful disinfectant, quickly destroying all forms of vegetable life. It exerts a sedative effect on the mucous membrane of the throat and adjacent parts, and is used for this purpose in the forms both of the honey and the glycerine of borax.

In the stomach it plays the part of a mild alkali, and being readily absorbed increases the alkalinity of the blood.

When given in large doses borax produces a certain train of symptoms to which the term "Borism" has been applied:—

Intestinal disturbance, with nausea, vomiting, and anorexia, is common.

Dryness of the skin, with redness and inflammation of the mucous membranes, is next noted.

There is an eruption on the skin which may assume the form of seborrhœic eczema, reddish patches which desquamate, or papules attended with much itching.

The hair is dry and comes off in large quantities.

There is a general weakness, due partly to the toxic effects of the drug and partly to the anorexia.

In severe cases albumin may appear in the urine.

Of late borax has been used in epilepsy. It is useful in certain cases in which the bromides have little or no effect, or are badly borne. In certain cases the bromides act

when borax fails, whilst, in another class of case, borax is useful where bromide fails to effect any beneficial change. Apparently borax does most good when the epilepsy is associated with gross organic disease.

It has some action as an emmenagogue, and increases the contractile power of the uterus. It is eliminated by the kidneys, and increases the flow of urine.

HYDROCYANIC ACID.

The substance used in medicine is dilute hydrocyanic acid—a two per cent. solution of anhydrous acid. The only preparation is the vapour or inhalation made by adding the dilute acid to cold water. Scheele's acid is a four per cent. solution.

The dilute hydrocyanic acid is a colourless liquid easily recognizable by its characteristic odour of bitter almonds. As a rule it is better not to taste it. Although nominally a two per cent. solution it varies much in strength, some specimens being as low as 0·6 and others as high as 3·2 per cent., this variation depending on the mode of manufacture, the length of time the specimen has been kept, and the degree of exposure to light.

Prussic acid is fatal to all forms of animal and vegetable life, and even prevents decomposition and fermentation. It acts energetically as a poison by whatever channel it is introduced into the body. Whether it is swallowed, or dropped into the eye, or applied to wounds or cuts, or inhaled, its action is exerted with tremendous energy. People have fallen down insensible from merely smelling a bottle of the strong acid.

In man, the symptoms appear very rapidly, indeed, often in a few seconds. When the dose taken is less than a fatal

one, giddiness, staggering, insensibility, and loss of motor power are quickly noticed, and these are succeeded by violent gasping for breath, panting respiration and perhaps tetanic convulsions. This spasmodic condition is due to irritation of the respiratory and so-called spasm centres in the medulla oblongata. When a fatal dose is taken, the patient is nearly always insensible in two minutes. The poison passes rapidly into the blood and is speedily eliminated by the breath, so that if life can be maintained, even for half an hour, recovery takes place. The symptoms are similar to those of asphyxia, except that the blood is red and artificial respiration will not avert death. The cause of this asphyxia is not certain, but it is known that hydrocyanic acid forms with hæmoglobin a special compound which can take up oxygen, but parts with it with difficulty.

Hydrocyanic acid is a general protoplasmic poison, and quickly abolishes the functions of all the tissues. It paralyzes first the brain, then the cord, and finally the motor nerves and muscles. The heart stops in diastole, and its arrest is due partly to the action of the poison on its ganglia and the muscular tissue, and partly to irritation of the central origin of the inhibitory fibres of the vagus and of the vaso-motor nerves.

In fatal cases the symptoms usually commence in the act of swallowing, or at all events immediately afterwards, and their appearance is rarely delayed beyond one or two minutes. The question is often discussed in relation to medico-legal investigations as to whether a person who has swallowed a fatal dose of prussic acid is capable of performing any voluntary act, and the reply is unhesitatingly in the affirmative, for in more than one instance the patient has attempted to reach an antidote and has even been heard to call out loudly for hartshorn.

In small medicinal doses the dilute acid acts as a sedative

to the mucous membrane of the stomach, and is not uncommonly given in conjunction with bismuth.

The leaves of the common cherry laurel (*Prunus laurocerasus*) owe their activity to the prussic acid they contain. Laurel water obtained by distillation is an active poison, and many deaths have occurred from its administration. It is so variable in strength that it is unsuited for administration as a medicinal agent. The essential oil of bitter almonds also owes its properties to the presence of prussic acid. It, too, varies much in strength, but is usually about four times as strong as the dilute acid.

It is hardly necessary to say that in physiological action hydrocyanic acid is not in any way allied to hydrochloric, sulphuric, or nitric acid. The juxtaposition is due to the syllabus laid down for the use of students by examining boards, and the arrangement is not a scientific one.

AMMONIA, POTASH, AND SODA.

By ammonia is meant in the Pharmacopœia the liquor ammoniæ fortior or strong solution of ammonia, of which there are two preparations, the liquor ammoniæ, one-third the strength of the strong solution, and the linimentum ammoniæ or "hartshorn and oil," a mixture of ammonia and olive oil. The aromatic spirits of ammonia or "sal volatile," although nominally a preparation of the carbonate, owes its properties as a stimulant, and to some extent as an antispasmodic, to the free ammonia which it contains.

Ammonia has a strong alkaline reaction, and readily enters into combination with acids. The liquor ammoniæ, being an aqueous solution, displays but little affinity for water, but has a high diffusion power and readily penetrates the cuticle, destroying the tissues with which it comes in

contact and producing a slough or ulcer. Applied to the skin—say in the form of the liniment—it is rubefacient and counter-irritant, especially if the application is prolonged. If a piece of cotton wool is dipped in strong ammonia, placed on the skin and covered with a watch-glass, it acts as a vesicant, producing a blister.

When inhaled—in the form of smelling salts, for example —ammonia stimulates the mucous membrane, excites the vaso-motor centre, heightens blood pressure, and increases the rapidity of the heart's action. It is a powerful stimulant and always strengthens the force of the heart's beat, and increases the frequency of the pulse. In frogs the ammonium salts in small doses strengthen the ventricular action, but in larger quantities destroy muscular contractibility.

In the stomach ammonia excites a sensation of warmth and neutralizes any excess of acid. After large doses there is an increased secretion of mucus which may give rise to vomiting.

Ammonia is quickly absorbed, and presumably increases the alkalinity of the blood. In large doses it interferes with the respiratory function from its action on the red blood corpuscles. When injected hypodermically in large doses in animals it gives rise to convulsions and spasmodic breathing, due to irritation of the spinal cord and medulla. Its influence is transitory, for owing to its high diffusion power it is speedily eliminated, partly by the lungs and partly by the urine. It is partly converted into urea from contact with carbonic acid in the blood.

Potash has a high diffusion power, and a strong affinity for water. It dissolves nitrogenous tissues. Potassium—speaking now of the base generally—is a protoplasmic poison which destroys all structures with which it is brought in contact in a sufficiently concentrated form, muscle, nerve,

and nerve centres especially. In small doses it increases the contractile power of muscular tissue, but in large doses it abolishes it entirely.

Potash induces spasmodic contraction of the muscular tissue of the frog's heart, followed by paralysis. Potassium is a far more powerful paralyzer than either sodium or ammonium, and this is the explanation of the preference displayed by many prescribers for iodide of sodium and bromide of sodium over the corresponding potassium salts.

Potash as an alkali increases the secretion of the gastric juice, the rule being that alkalies increase acid secretions. From the stomach it is absorbed into the circulation and converted into a carbonate. It increases the disintegration of the nitrogenous tissues. Potassium salts act on the circulation somewhat like digitalis. After the administration of large doses of potassium salts the symptoms noticed are muscular weakness with dyspnœa and convulsions.

Both potash and soda increase the excretion of uric acid. Potash renders the urine less acid or even alkaline. The amount of acid excreted with the urine is increased, but being neutralized by the base it produces no acid reaction.

The action of alkalies and of acids on the secretions is easily remembered—

Alkalies increase acid secretions and decrease alkaline secretions.

Acids increase alkaline secretions and decrease acid secretions.

In other words, an alkali or an acid checks the formation of a secretion of its own reaction.

AMMONIUM CARBONATE.

This salt has an alkaline reaction, smells strongly of ammonia, and has a high diffusion power.

When inhaled it stimulates the mucous membrane, excites the vaso-motor centre, and increases blood pressure.

By virtue of its alkalinity it stimulates the secretion of the gastric juice, by which it is neutralized and decomposed.

Carbonate of ammonium stimulates the respiratory centre and acts as an expectorant.

In large doses it is an emetic, acting reflexly on the vomiting centre.

In the lower animals, when injected under the skin or directly into the circulation, it produces convulsions accompanied by spasm of respiration, an effect due to its action on the medulla oblongata and spinal cord.

Carbonate of ammonium is one of the constituents of the ordinary smelling-salts used for cold in the head. They usually consist of sawdust as a basis with carbonate of ammonium, strong solution of ammonia, carbolic acid, camphor, and aromatics.

The following is a useful formula—

ANTI-CATARRHAL SMELLING SALTS.

Carbolic acid	30 grs.
Carbonate of ammonium	1 oz.
Powdered charcoal	1 oz.
Oil of lavender	20 mins.
Compound tincture of benzoin ...	½ fluid oz.

Carbonate of ammonium is frequently administered in cases of chronic bronchitis, attended with difficult expectoration. It may be given in a mixture in conjunction with chloride of ammonium or iodide of potassium.

CHLORIDE OF AMMONIUM.

Chloride of ammonium or sal-ammoniac has no odour of ammonia. It is one of the salts purified by sublimation.

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The term "sublimation" is applied to solids, "distillation" to liquids. We speak of sublimed sulphur, and of distilled water. The difference between evaporation and distillation is that in evaporation the product is not condensed. Distillation is evaporation plus condensation.

Chloride of ammonium increases the secretions of all the mucous membranes, and may excite catarrh. The chlorides enter largely into the composition of mucus, and the chloride of ammonium probably acts by supplying it with one of its most important constituents. It is said to hasten nutritive changes in mucous membranes, and to favour exfoliation of epithelium. It exerts a special action on the gastric mucous membrane.

Having a high diffusion power it passes quickly into the blood. It does not reach the intestines, and does not act as a purgative.

It is not decomposed by the gastric juice, and does not act as a stimulant to the heart or influence the circulation. It is not given in syncope, and is not used in the form of smelling salts. It increases the formation of glycogen in the liver.

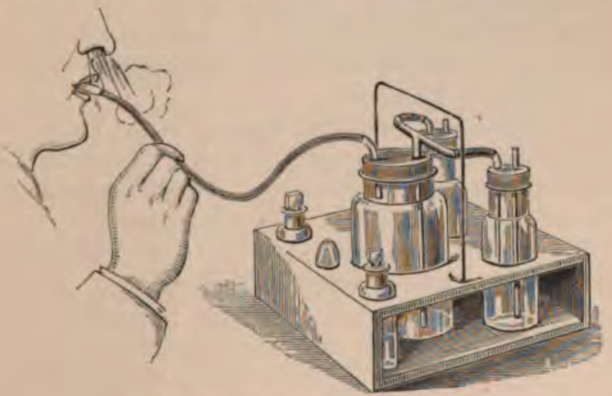
It is a nerve tonic and is largely employed in the treatment of neuralgia of the face and in sciatica. When given in large doses it usually acts promptly.

It is an alterative, and is useful in rheumatism and allied affections. The term "alterative" has no precise or definite meaning, and is consequently largely used. It may probably be taken to imply that it produces some alteration in the blood, the exact nature of which we do not understand.

Chloride of ammonium is not oxidized in the blood, and is eliminated completely by the kidneys unaltered. It increases all the constituents of the urine with the exception of the uric acid, which is slightly diminished. It may be detected in the saliva.

The dose of chloride of ammonium as an expectorant is ten grains three times a day, and as a nervine tonic forty grains three times a day. It is freely soluble in water, and its bitter taste is best covered by liquid extract of liquorice.

Nascent chloride of ammonium is of much value in the treatment of chronic bronchitis and winter cough. The fumes are generated by drawing air through hydrochloric acid and ammonia, and allowing the products to mix. Several forms of apparatus have been devised for this purpose, and the one I employ is shown in the accompanying figure. The large or wash-bottle contains water.



THE CHLORIDE OF AMMONIUM INHALER.

The amount of air passing through the acid or alkaline solution may be regulated to a nicety by raising or depressing the vertical glass tube with which each of the smaller bottles is furnished. It is important that the fumes should contain no free or uncombined acid; but it is still more important that they should contain no free ammonia, which acts as a powerful irritant to the glottis. I find it a good

plan to put a few drops of acetic acid in the wash-bottle, so as to neutralize any excess of ammonia. The water may be coloured with a little tincture of litmus, which indicates at a glance the presence of any uncombined alkali. The mouthpiece should be furnished with a long piece of indiarubber tubing, so that the patient may sit back in his chair and inhale in comfort. The fumes should be taken well into the chest, and not merely into the mouth. It is often desirable to "medicate" the fumes in various ways, and this may be done by adding a few drops of pure terebene, pinol, or oil of eucalyptus to the water in the wash-bottle. The apparatus is a good one; but it requires a little management, and the prescriber should personally superintend the first inhalation, or the patient will assuredly fail in his endeavours to draw the fumes well into his chest.

The chloride of ammonium lozenges of the Throat Hospital Pharmacopœia contain two grains in each, and are made up with black currant paste. Sucked frequently they are useful in the early stage of bronchial catarrh.

The following is a useful formula for bronchial catarrh and the early stages of chronic bronchitis:—

R.	Ammonii chlorid.	ʒii.
	Extract. glycyrrhizæ, liq.	ʒiii.
	Syrup. pruni virginianæ	℥ii.
	Syrup ipecac.	ʒiii.
	Aquæ.	℥iii.

M.—A tea-spoonful every three or four hours.

The syrup of Virginian prune and the syrup of ipecacuanha are not in the British Pharmacopœia, but they are both official in the United States Pharmacopœia.

Taking it all round chloride of ammonium is one of the most useful remedies at our disposal.

ACETATE OF AMMONIUM.

The liquor ammonii acetatis is the ancient spirit of mindererus, and was named after Minderer or Mindererus, who was the first to use it. It is a colourless fluid, and should be absolutely neutral to test paper.

There are two solutions of acetate of ammonium—the solution and the strong solution, although the latter is rarely prescribed.

Acetate of ammonium is not a cardiac stimulant, but acts as a vascular stimulant, dilating the blood-vessels and equalizing the circulation. It prevents the congestion of the internal organs, which might occur as the result of exposure to cold.

When the patient is kept warm it acts as a diaphoretic, promoting the action of the skin. When the body is cold and perspiration is not easily induced, it acts as a diuretic, increasing the urinary flow.

In large doses it is used in the treatment of difficult menstruation, and is probably an emmenagogue.

The dose recommended in the Pharmacopœia is from two to six drachms, but as much as four ounces may be given at a dose with safety.

POTASSIUM BICARBONATE.

Potassium bicarbonate has the usual physiological action of alkalies. In the stomach it increases the secretion of the gastric juice. It is readily absorbed, and probably promotes the alkalinity of the blood. It is eliminated by the kidneys, rendering the urine alkaline.

When a salt of potassium is administered to frogs the symptoms first noticed are loss of sensation and of voluntary and reflex action, whilst considerable voluntary power remains so that the animal, without sensation and without reflex action, still hops vigorously. The mode of action of potassium salts is easily explained. They paralyze all nitrogenous tissues. They have an equal affinity for all protoplasms, and destroy the tissues in the order of their vital endowments. They arrest the heart, not from any specific action on that organ, but owing to their common action on protoplasm. By arresting circulation they depress the reflex action of the cord, and impair the functions of the brain.

CHLORATE OF POTASSIUM.

There is much difference of opinion respecting the value of chlorate of potassium as a remedial agent. It came late comparatively to many other of the potassium salts into therapeutic consideration. Lauded at first as an almost universal panacea, it was quickly consigned to the lumbo of dangerous or doubtful drugs, and finally came to be regarded as useless except as a purely topical medicament. It was originally employed on the theory that it yielded oxygen to the system in diseases in which the blood was supposed to be deficient in that element. When it was discovered that it was eliminated unchanged by the urine, this theory had to be abandoned, and those who were formerly most enthusiastic in its praise ceased to employ it.

Chlorate of potassium increases the flow of saliva, which becomes distinctly acid, and if its use is long continued may produce ulceration of the mucous membrane of the mouth. Its beneficial effect in many throat affections is due to a

local antiseptic action. A small quantity of chloric acid is set free from the base, and this nascent chloric acid acts as a disinfectant.

Large doses greatly improve the appetite, but may induce inflammation of the mucous membrane of the stomach, and give rise to vomiting and purging.

Chlorate of potassium passes rapidly into the circulation. In the blood it converts the hæmoglobin into methæmoglobin. The blood assumes a chocolate colour, and loses its power of parting with oxygen. The corpuscles swell up and part with their colouring matter to the liquor sanguinis. There is no evidence that the salt is decomposed, or that it parts with its oxygen. Small doses at first depress and afterwards raise the blood pressure and accelerate the pulse. Large doses may arrest the respiratory function and lower blood pressure without materially affecting the heart.

The urine is blood-stained, and contains casts plugged with coagulated blood. The salt is eliminated unaltered. It may be detected in the secretions of the mouth.

The chief therapeutical use of chlorate of potassium is in the treatment of affections of the mouth, gums, throat, and adjacent parts. It is useful in salivation in ulcerative stomatitis, and in follicular and phagedenic ulceration. A saturated solution of the salt in water forms a good gargle, or tabloids of chlorate of potassium or of chlorate of potassium and borax may be used. Dr. Lloyd Roberts, of Manchester, finds that the lotion is useful in the teazing dryness of the mucous membrane of the throat left after diphtheria.

For internal administration chlorate of potassium is best given either in milk or with some aërated water. It would be safe to give from a drachm to two drachms three times a day, but death has resulted from a single dose of six hundred grains, and from doses of three hundred administered on four successive days.

ACID TARTRATE OF POTASSIUM.

This substance is commonly known as bitartrate of potassium or cream of tartar.

It has a low diffusion power, so that very little passes from the stomach into the blood.

In the intestines it stimulates the mucous membrane to increased secretion. This occurs chiefly in the small intestine, and it is a true secretion, and not merely the result of irritation or of osmosis. This secretion carries off urea and other waste products. There is no increased peristalsis, but when the acid tartrate of potassium is combined with a drug which has this property, it acts as a powerful hydragogue purgative.

When the dose is too small to excite purgation the drug is absorbed from the intestines and passes into the blood. In the blood it is converted into the carbonate and acts as a diuretic, increasing the secretion of the urine and rendering it less acid or even alkaline.

Acid tartrate of potassium is often prescribed in the form of the haustus imperialis or imperial drink, which is largely used for febrile patients. The formula is:—

Acid tartrate of potassium	1 dr.
White sugar	4 drs.
Boiling water	1 pt.

"Baking powders," as a rule, consist of cream of tartar and bicarbonate of sodium in equivalent proportions, with the addition of a small amount of dehydrated starch to keep the materials dry and prevent chemical action before they are used. The great advantage of cream of tartar for this purpose is that it dissolves somewhat slowly, so that it does not liberate the whole of the carbonic acid in a rush.

If the cream of tartar and bicarbonate of sodium were chemically pure they would be combined in the proportion of forty-seven parts of the former to twenty-one of the latter, but as the tartrate of potassium usually contains at least five per cent. of neutral salts, the best results are obtained by mixing seven parts of the best commercial cream of tartar with three parts of bicarbonate of sodium and one part of starch dried at a temperature of 230° F. In a fatal case of poisoning by baking powder, which was referred to me for report, one end of the packet consisted almost entirely of oxalic acid, but how it came there no one seemed to know.

PERMANGANATE OF POTASSIUM.

This salt is met with in the form of purple acicular crystals which are readily soluble in water and have a sweet astringent taste.

There is only one preparation.

LIQUOR POTASSÆ PERMANGANATIS, the solution of permanganate of potassium. It contains 88 grains to the ounce. There are 8·750 grains in a pint, so that it is a one per cent. solution—the usual strength of a liquor.

Condy's fluid is a two per cent. solution.

Permanganate of potassium is a powerful oxidizer, and gives off oxygen so readily that if mixed with any oxidizable substance such as sugar, syrup, or glycerine, the mixture catches fire or may even explode spontaneously.

Pills of permanganate of potassium should be made with prepared kaolin, or Chinese chalk, a native white silicate of aluminia purified by elutriation. Elutriation is the process of powdering rough insoluble substances and mixing them

with water so that the finer portions may be poured off, the heavier particles sinking to the bottom.

Permanganate of potassium yields ozone, and is largely used as a disinfectant and deodorizer, although its sphere of action is limited. It destroys organic matter, and if mixed with cobra poison renders it inert.

It is used with much success in the treatment of amenorrhœa, but its mode of action is uncertain.

It should be administered after meals, and should be followed by a tumbler of water, or it will irritate the stomach and œsophagus and cause a good deal of pain.

The dose of permanganate of potassium in cases of amenorrhœa is from one to two grains three times a day. The solution is too nasty to take, and the drug must be given either as a pill or tabloid. If the pills are made up with a fatty substance and taken on an empty stomach, they produce much gastric disturbance attended with pain and vomiting. If, however, they are made up with kaolin and given immediately after meals, they are perfectly safe. Many medical men seem to be afraid to prescribe them, and always order binoxide of manganese, which is non-irritating, and in doses of two grains is almost equally efficacious in establishing the menstrual flow.

Permanganate of potassium has recently been introduced as an antidote in cases of poisoning by opium and morphine. It has long been known that morphine is readily oxidized by the permanganate, the latter being reduced to hydrated manganese dioxide. It is stated on the authority of Dr. William Moor, of New York, that the oxidization of morphine renders it perfectly innocuous, depriving it entirely of its toxic properties. It was thought that the presence of albumin in the stomach would prevent this reaction, but it was found that the permanganate reduces sulphate of morphine infinitely more rapidly than it does albuminous matter,

the permanganate exhibiting a peculiar selective affinity for morphine. This is demonstrated by a very simple experiment. A solution is made containing 250 grains of white of egg and one grain of sulphate of morphine in an ounce of water. To this is added one grain of permanganate of potassium, also dissolved in an ounce of water. After rapidly mixing the solutions not the slightest trace of morphine can be detected. It appears that a grain of the permanganate exactly oxidizes one grain of morphine, but it is better as a matter of precaution to take a grain over the quantity of the permanganate absolutely necessary to neutralize the alkaloid. Dr. Moore, who states that he is extremely susceptible to the action of narcotics, made some experiments on himself which are of much interest. On the first occasion, after a light supper, he took three grains of sulphate of morphine, followed, half a minute later, by four grains of potassium permanganate dissolved in water. He experienced no ill effects, although from his peculiar susceptibility to the drug he would have been affected had even an eighth of a grain of morphine been absorbed. On another occasion he took, two hours after breakfast, five grains of sulphate of morphine in an ounce of water, followed almost immediately by eight grains of the antidote dissolved in eight ounces of water. In cases of poisoning by any of the salts of morphine, from eight to ten grains of the permanganate of potassium should be dissolved in a pint of water and administered at once, the dose being repeated at intervals of half an hour once or twice. This treatment promises well, and is likely to be largely employed, especially from the fact that the permanganate, from its use as a disinfectant, is found in almost every household, or can be obtained at a moment's notice. Condy's fluid is a two per cent. solution, so that an ounce in a pint of water would be practically the correct dose. In cases of

poisoning by morphine itself (not its salts), or by opium or its preparations, it would be advisable to add a couple of tea-spoonfuls of white vinegar to the antidote, so as to convert the morphine into a soluble salt. When the patient is insensible the antidote may be introduced by the stomach-pump, or, better still, by a piece of rubber tubing passed through the nostril into the stomach. The tube, furnished at its free extremity with a glass funnel, could be readily filled, and by depressing its extremity could be made to act as a syphon, so as to wash out the stomach every few minutes. As morphine after being absorbed is again eliminated by the mucous membrane of the stomach, it would be well to give a weak solution of the antidote, say a grain in a tumblerful of water, hourly for some hours, even when all the opium or morphine is supposed to have been rendered inert.

Permanganate of potassium exhibits a similar selective affinity for eserine in the presence of albumin. On the other hand, it exerts no oxidizing effect on atropine, hyoscyamine, hyoscine, cocaine, aconitine, veratrine, pilocarpine, muscarine, caffeine, or phosphorus. Moreover, it gives up its oxygen much more quickly to albuminous matter than to strychnine, oxalic acid, colchicum and hydrocyanic acid.

The permanganate is apparently an antidote for opium and morphine, and for physostigma and eserine, but not, as far as we know, for other poisons.

BICARBONATE OF SODIUM.

There are two preparations of bicarbonate of sodium, the liquor sodæ effervescens and the trochisci sodii bicarbonatis. The effervescing solution of soda is sometimes called soda

water, but the ordinarily accepted soda water of commerce is simply a solution of carbonic acid in water charged under pressure. The lozenges are made with a hard basis of gum acacia and mucilage, and are less useful than the tabloids of bicarbonate of soda sold by most chemists.

Bicarbonate of sodium has the ordinary action of alkalies in checking alkaline and increasing acid secretions. If given before meals it augments the flow of the gastric juice. It passes readily from the stomach into the circulation, and increases the alkalinity of the blood. It is eliminated by the kidneys and renders the urine less acid, or even alkaline.

SULPHATE OF SODIUM.

Sulphate of sodium, or Glauber's salt, is a purgative which produces watery motions.

The common saline purgatives are:—Sulphate of sodium, sulphate of magnesium (Epsom salts), sulphate of potassium, phosphate of sodium, tartrate and bitartrate of potassium, tartrate of potassium and sodium (Rochelle salt), citrate of potassium, citrate of sodium, and citrate of magnesium.

Matthew Hay has investigated the action of saline purgatives—sulphate of sodium especially—on rabbits, cats, and dogs.

Sulphate of sodium excites an active secretion in the intestines, probably for the most part in the small intestine, the excito-secretory influence of the salt being due partly to its bitterness, and partly to its irritant and specific property, and not to osmosis. The secretion is, in the main, a true succus entericus, but the bile and pancreatic juice also participate in the action. The low diffusibility of the salt impedes the absorption of the fluid, so that between stimulated secretion on the one hand, and impeded absorption

on the other, there is an accumulation of fluid in the canal. This fluid, partly from ordinary dynamical principles and partly from gentle stimulation of the peristaltic movements excited by distension, wends its way along the intestine until it reaches the rectum and produces purgation. As the intestinal secretion excited by the salt contains very little organic, as compared with inorganic matter, the purgative action removes from the blood more of the latter than of the former.

The action of the drug depends to some extent on the strength of the solution employed. Thus, four grammes of a purgative salt well diluted with water so as to form a $2\frac{1}{2}$ per cent. solution, produced active purgation in a rabbit, whilst twice that dose, administered in the form of a 20 per cent. solution, produced no effect when administered to a rabbit which had been for some days on a water-restricted diet. As a rule, the more dilute the solution the more prompt the effect. Sulphate of sodium will not produce catharsis if given in a concentrated form, when little or no water is taken with the food for some hours previously.

The essential character of a saline cathartic, which enables it to act so much more powerfully than a non-purgative salt, seems to be the possession of the peculiarity of bitterness. A bitter substance in the mouth stimulates the flow of saliva, and it is probable that a bitter substance in the intestines stimulates the flow of the succus entericus. The property of slow diffusibility is an important one, for whilst the bitterness promotes the secretion, the slowness of diffusion prevents the absorption of the fluid. In addition to being a powerful intestinal stimulant it is also a powerful hepatic stimulant. This is of much importance in the selection of a purgative water. It has been found by analysis that in 16 ounces troy there are of sulphate

of sodium in Carlsbad water (Sprudel) 19·9 grains, in Friedrichsthal water 46·5 grains, and in Hunyadi Janos water from 122 to 173 grains. The Hunyadi Janos is clearly the best hepatic stimulant.

When injected into the blood sulphate of sodium excites no intestinal secretion, and does not act as a purgative. It has no toxic action.

The quantity of the normal constituents of the urine is not affected by the salt.

Hunyadi Janos water taken in the morning before breakfast is an excellent laxative. It should be mixed with an equal quantity of boiling water and sipped slowly whilst dressing. Its bitterness is by no means disagreeable, and many people soon acquire a liking for it. Its great advantage is the promptness of its action. There is one complete evacuation of the bowels without griping or straining, and then there is no further trouble during the rest of the day. The dose can be regulated to a nicety, and when once the action is established there is no fear of its losing its effect. It is admirably adapted to the requirements of middle-aged men who lead a sedentary life and are precluded by the nature of their occupations from taking much active exercise. It stimulates the liver to action, and improves not only the appetite but the digestive powers.

CALCIUM OXIDE AND CARBONATE.

There are four preparations of lime :—

1. Calcis hydras—slaked lime.
2. Liquor calcis—lime water.
3. Liquor calcis saccharatus—saccharated lime.
4. Linimentum calcis—liniment of lime.

The strength of the liquor is half a grain to the ounce. The liquor hydrargyri perchloride is of the same strength, but most liquors are one per cent. solutions.

Lime dissolves readily in sugar, and the saccharated solution is about sixteen times as strong as the ordinary lime water.

The liniment consists of equal parts of lime water and olive oil. A mixture of equal parts of lime water and linseed oil is known as Carron Oil, from being used at the Carron Iron Works in the treatment of burns.

The carbonate of lime exists in several forms :—

1. Calcii carbonas precipitata—precipitated carbonate of lime.
2. Marmor album—white marble.
3. Creta—chalk.
4. Creta preparata—prepared chalk.

There are two preparations of prepared chalk :—

1. Mistura cretæ—chalk mixture.
2. Pulvis cretæ aromaticus—aromatic powder of chalk.

The pulvis cretæ aromaticus cum opio is more conveniently considered as a preparation of opium.

Lime is of considerable interest to the pharmacologist. Having but little diffusion power its action on the skin is slight. In the form of caustic lime it withdraws water from the tissues and to some extent destroys them, although only superficially. Lime water, or the carbonate applied to the abraded skin, is astringent, and checks excessive discharges probably by combining with albumin.

Lime neutralizes any excess of acid in the stomach or intestines. It is but slowly absorbed, and passes into the blood only in small quantities, although sufficient is taken

up to promote nutritional changes. Lime is an essential constituent of the hard and soft tissues of the body, including the muscles, nerves, and bones. Wherever there is active growth lime salts are present in excess.

Lime exerts a digitalis action on the heart. When the proportion of lime present is deficient the contractions are weak, but when the quantity is increased they become powerful.

Lime is eliminated by the intestines, and to some extent by the kidneys, for the urine becomes alkaline when it is administered.

Chloride of calcium is frequently given in phthisis and in the wasting diseases of children. It is administered in doses of from twenty to thirty grains three times a day. It is freely soluble in water, and the solution may be flavoured with glycerine.

MAGNESIA.

The term magnesia may be taken to include magnesia ponderosa or heavy magnesia, and magnesia levis or light magnesia, sometimes called light calcined magnesia.

The two varieties of magnesia differ only in their consistence, light magnesia being three and a half times as bulky as the heavy form.

Magnesia when introduced into the stomach acts as a direct antacid, neutralizing the acid with which it comes in contact. Some of the magnesia is converted into a chloride, but it has a low diffusion power, and but little of it is taken into the circulation. The greater part passes along the intestines unaltered. The chloride is probably decomposed by the bile in the intestines, and reconverted into the oxide. This, by the action of carbonic acid, becomes first a carbonate

and then a bicarbonate, which acts as a laxative and slight aperient.

When magnesia is taken in large quantities there is a risk of its forming concretions in the intestines. It is eliminated chiefly with the fæces, but a portion is absorbed, and combines with uric acid and urates, rendering the urine alkaline.

SULPHATE OF MAGNESIUM.

Of this useful medicine, commonly known as Epsom Salts, there is only one preparation, the enema, but it enters into the composition of the black draught of commerce.

Its action is in some respects similar to that of sulphate of sodium. It is a more active purgative, a property probably attributable to its greater degree of bitterness. It only slightly stimulates the peristaltic action of the intestine, so that if given alone a portion of the fluid secreted may be reabsorbed.

Rutherford has shown that it is not a hepatic stimulant, and that in purgative doses it diminishes the secretion of the bile. In this respect it differs markedly from sulphate of sodium. The best aperient saline water is that which contains the largest percentage of sulphate of sodium.

In the black draught sulphate of magnesium is combined with senna, which, by stimulating the muscular coat of the bowel, increases its purgative action.

When injected into the circulation it acts as a powerful toxic agent, paralyzing first respiration, and then the heart. It abolishes sensation, and paralyzes the sensory-motor reflex centres.

When absorbed it acts as a diuretic if the surface of the

body is exposed, but as a feeble diaphoretic if the patient is kept warm.

The bitter taste of Epsom Salts may to some extent be covered by the addition of coffee or syrup of coffee to the solution, but possibly this addition may impair its usefulness as a purgative.

The effervescent sulphate of magnesium, or effervescent Epsom Salts, is a useful preparation, and forms a pleasant saline purgative.

ALUM.

There are two kinds of alum—potash alum, which is a sulphate of aluminium and potassium, and ammonia alum, which is a sulphate of aluminium and ammonium. They both crystallize in octahedra, and have identical pharmacological properties. There is also a dried alum, which is a potash alum deprived of its water of crystallization. There is no preparation for internal administration, but glycerine of alum, a solution of alum in glycerine, is used as a local application.

Alum is employed chiefly as a topical astringent. It precipitates albumin and gelatin. It acts as an astringent in virtue of its capacity to unite with and coagulate albumin. When applied to the unbroken skin it exerts no effort, but when it comes in contact with the albumin of pus, or of mucus, or of the tissues themselves, it forms an impermeable layer and protects the parts from the air. In addition to its protective action it is a styptic, arresting the flow of blood from abraded surfaces or ruptured blood-vessels.

Dried alum abstracts water from the tissues, and is a slight caustic. The part should be wiped dry, so that the alum may exert its full action.

Alum possesses some powers as an antiseptic. It exerts a bracing or astringent action, as, for example, when used as a gargle in relaxed sore throats.

In the stomach alum coagulates the albumin, constringes the mucous membranes, and arrests the digestive process. It is an emetic, acting topically, that is to say reflexly on the vomiting centre. In large doses it may give rise to gastro-enteritis. It checks the secretion from the mucous membrane of the intestines, and by rendering the fæces harder and more difficult of expulsion causes constipation.

It is absorbed from the stomach and intestines, but only in small quantities. There is no evidence that it exerts any astringent action on the lungs, kidneys, or other organs, although it is frequently prescribed in the treatment of the night-sweating of phthisis. It is eliminated by the fæces, which it rendered odourless.

Alum was at one time largely employed as an adulterant for bread, being used to give a whiter colour to the flour. It produced indigestion and constipation from lessening the nutritive value of the bread, by combining with the phosphoric acid and rendering it insoluble. It is probable that alum is not so largely used by bakers as formerly, but as much as forty grains have been detected in a four-pound loaf. The use of alum in making bread is illegal.

OXIDE OF ZINC.

Oxide of zinc is a sedative to the skin, and is frequently used mixed with starch as a dusting powder.

The only preparation of the oxide is the ointment—the common zinc ointment—made with benzoated lard.

The oxide is but slightly soluble in the gastric juice unless much acid is present, but some of it must be

absorbed, as evidenced by its astringent effect, especially in checking the night sweating of phthisis.

The oxide of zinc has been so long used to check the night sweating of phthisis that the origin of the treatment is lost in obscurity. As far back as 1837, Dr. Busse, of Berlin, recorded the case of a man who, after taking twenty grains of the drug daily for some months for epilepsy, became cold and shrivelled and his skin like parchment. Some years later Dr. Robert Dickson, of the Hospital for Consumption at Brompton, again noticed the property of drying the skin in the case of patients to whom he administered the drug as a general tonic and for diarrhœa, and this induced him to give it with a view of checking nocturnal perspirations. The treatment was alluded to in a lecture delivered by Dr. Theophilus Thompson, in 1851, and since then it has been very generally employed, although it has to some extent been superseded by more recent introductions.

The oxide does not produce emesis. Its other actions are identical with those of the sulphate.

Calamine, an impure oxide, or a mixture of oxide and carbonate, is employed for the same purpose, especially in the form of a lotion.

The following lotion is a useful application for the face. It is cooling, and affords great relief in cases of eczema and acne:—

Calamine	6 drs.
Oxide of zinc	3 drs.
Glycerine	½ oz.
Elderflower water	4 ozs.
Rose water	to ½ pint.

The lotion is dabbed on the face with a small sponge, and is allowed to dry, the superfluous powder being dusted off with a soft pocket-handkerchief.

In cases of catarrh of the nasal regions, coryza, and nasal polypus, the following powder is excellent :—

Dermatol	4 drs.
Calamine	4 drs.
Oxide of zinc	4 drs.
Boracic acid	to 2 ozs.

The ingredients should be finely powdered and intimately mixed. It should be used three or four times a day with an insufflator.

Dermatol is not official. It is a basic gallate of bismuth, and in addition to being an astringent is an antiseptic.

The ordinary dusting powder consists of one part of oxide of zinc and two of powdered starch.

The oxide of zinc pills used for checking the sweating of phthisis contain two and a half grains in each, and are made up with extract of liquorice. Extract of belladonna is often added, but there seems to be no object in employing two active drugs when one will do. Two of the oxide of zinc pills at bedtime will check the sweating.

SULPHATE OF ZINC.

Sulphate of zinc is met with in the form of small acicular crystals, almost identical in shape with those of sulphate of magnesium.

It is slightly efflorescent, and is freely soluble in water. The term "efflorescence" means giving up water to the air; "deliquescence" means absorbing water from the air.

Sulphate of zinc, when applied to the abraded skin, coagulates albumin and contracts the blood-vessels.

It is an astringent when applied to mucous membranes, and lessens discharges.

Sulphate of zinc acts as a speedy emetic, producing rapid

evacuation of the contents of the stomach. This action is due partly to the topical effect on the stomach, and partly to stimulation of the vomiting centre in the medulla oblongata after absorption. It acts equally well as an emetic when injected into the circulation. Its action in this case must be chiefly on the vomiting centre, but probably some of the drug is excreted by the mucous membrane of the stomach, and acts locally.

Zinc is not deposited in the tissues in the same manner, or at all events, for so long a period, as mercury, lead, or copper.

Sulphate of zinc, after absorption, acts as a nerve tonic, and is largely employed in many affections of the nervous system. Tolerance is soon established, and large doses, as much as forty grains three times a day, may be taken without inducing nausea or vomiting.

Sulphate of zinc is used in diarrhœa, but its astringent effect must be exerted chiefly on the upper part of the intestine, for in its progress through the intestinal tract, it is soon converted into an insoluble sulphide.

The prolonged use of medicinal doses of the zinc salts may induce a condition similar to chronic saturnism. Zinc colic, analogous to lead colic, sometimes occurs. The chief symptoms are constipation, vomiting, prostration, and a metallic taste in the mouth. There is a disease known as "Brassworkers' Disease," but it is not clear whether the symptoms are due to zinc or copper, both of which enter into the composition of brass.

Zinc is eliminated partly with the urine and partly with the fæces. It is probable that much of the sulphate is absorbed by the stomach, and is then eliminated by the mucous membrane of the intestine, and with the bile.

The dose of sulphate of zinc as an emetic is a scruple—thirty grains; and a good formula for an emetic draught is

sulphate of zinc, thirty grains, with powdered ipecacuanha, fifty grains, to be taken in water. It is far less active than apomorphine.

Sulphate of zinc in two-grain doses will check the night-sweating of phthisis, but the oxide is usually employed for this purpose.

The ordinary red wash so largely employed in hospital practice as a dressing for wounds, and indolent ulcers, is composed of sulphate of zinc, twenty grains; compound tincture of lavender, two drachms, and water to half a pint.

SULPHATE OF COPPER.

This salt is commonly known as "blue stone," or "blue vitriol." Sulphate of iron is called "green vitriol," whilst sulphate of zinc is "white vitriol," and the popular name for sulphuric acid is "oil of vitriol." Nitric acid is "aqua fortis," hydrochloric acid "spirits of salts."

Sulphate of copper is met with in the form of large azure-blue crystals, which have a styptic taste, are slightly efflorescent and dissolve freely in water.

Sulphate of copper is astringent; when applied to denuded surfaces, it coagulates albumin, constringes the blood-vessels, and covers the part with a pellicle which protects it from contact with the air. If the application is a strong one, it may act as an irritant and produce pain and smarting. It is as a mild caustic.

In the mouth it combines with albumin, precipitating it more or less completely.

Given by the stomach it acts as an emetic, producing one copious evacuation unattended with much nausea. It exerts its action partly on the stomach and partly on the vomiting

centre. It acts equally well when injected into the circulation, acting directly on the vomiting centre and also on the stomach, by the mucous membrane of which it is partly eliminated. It is absorbed from the stomach, and exerts a tonic and astringent action on the tissues. It promotes assimilation and acts as a tonic. It is excreted by the kidneys, and also by the intestines when it appears in the fæces, which it turns black. If taken for some time it produces colic, with alternate constipation and diarrhœa. It may cause paralysis of the extensor muscles of the arms.

People who work in copper mines are liable to a peculiar greenish coloration of the hair. The hair of the beard and moustache is first affected, and then the hair of the scalp. Copper can be detected in the hair chemically, and under the microscope the coloration is seen to be uniformly distributed.

Sulphate of copper is prescribed in cases of obstinate diarrhœa, such as the diarrhœa of phthisis or of enteric fever. The dose should not exceed a quarter of a grain, and it may be given in a pill with a quarter of a grain of extract of opium. At one time the copper salts were used in the treatment of chorea, epilepsy, and other diseases of nervous origin, but of late they have given place to other and better remedies.

Copper is used to colour tinned peas and other vegetables, often in such quantities as to be distinctly prejudicial to the consumer.

NITRATE OF SILVER.

Nitrate of silver when applied to the skin acts as a caustic, but it has little power of penetration and cannot

destroy the tissues to any depth. When applied to the denuded skin it forms a protective film or covering. It contracts the superficial blood-vessels, and acts as a local astringent.

In the mouth it exerts an astringent action, and is converted into an albuminate. In the stomach it acts as an irritant, unless there is sufficient albumin present to arrest its action.

It is absorbed into the blood in the form of a double chloride and albuminate, partly from the stomach and partly from the intestines.

It is eliminated slowly, so that if administered continuously it may produce the conditions to which the term *argyria* is applied. The gums show the earliest indication of this condition by a blue line which is darker than that produced by lead. Next the lanulæ of the nails, the eyeballs, and the skin of the face and hands are affected. The discoloration is increased by exposure to light, until the skin becomes almost black. It is permanent and persists for life. On microscopical examination dark granules of the metal are found in the cuticle, in the walls of the sweat glands, in the hair follicles, the sarcolemma, the neurilemma, the middle coat of the arteries and veins, the cerebral and spinal membranes, the laryngeal and bronchial membranes, the peritoneum and other parts. The discoloration is due to the deposit of the metal in a very finely divided state. If the administration of the drug is stopped on the appearance of the first symptoms, no further blackening occurs. The quantity required to produce this condition is not known, but probably less than an ounce, extending over a period of some three or four months, would suffice. It would be safe to give the drug in ordinary doses without intermission for six to eight weeks. This condition has been known to follow its local application, as in the case

of a girl whose throat was repeatedly cauterised with nitrate of silver with the production of all these symptoms.

The long continued administration may also cause loss of appetite, impaired nutrition, and rapid irregular action of the heart. Post-mortem there is fatty degeneration of the heart, liver, and lungs.

In the lower animals, nitrate of silver excites convulsions, followed by paralysis, of central origin. The convulsions are similar to those produced by strychnine. In fatal cases death is due to asphyxia, and the lungs are found congested, the bronchial tubes being choked with mucus.

It is eliminated by the bile and intestines, very little escaping with the urine.

MERCURY.

There are eight preparations of metallic mercury, and of these the blue pill and grey powder are of especial interest, from the fact that their activity is due to the presence of the metal in a finely divided state. These are true triturates, for "they owe their value to the presence of mercury in a very highly divided state caused by long trituration" (Garrod).

There are two oxides of mercury, the yellow oxide from which is obtained the oleatum hydrargyri, a solution of the oxide in oleic acid, and the red oxide of which there is one preparation, the unguentum hydrargyri oxidi rubri.

There are two chlorides of mercury, the perchloride or corrosive sublimate, and the subchloride or calomel. There are two preparations of the perchloride—yellow wash, a mixture of the perchloride with lime water, and the liquor, the strength of which, like that of the liquor calcis, is exceptional, being half a grain to the ounce.

There are three preparations of the subchloride—the old

familiar black wash, the calomel ointment, and the compound calomel or Plummer's pill, which it is hardly necessary to say does not contain lead.

There are two iodides of mercury, the red and the green, but for some inexplicable reason the green was omitted from the last edition of the Pharmacopœia. The red iodide is the periodide and corresponds to corrosive sublimate, whilst the green iodide is the subiodide and corresponds to calomel. There is one preparation of the red iodide—the ointment.

Sal Alembroth is a double chloride of mercury and ammonium. It is a powerful antiseptic, but as it combines with albumin less readily than the pure perchloride, it is not so irritating to the animal tissues.

Metallic mercury in the liquid state is rarely used in medicine, but in former times it was employed for the following purposes:—

1. As a solvent for silver coins accidentally swallowed.
2. For its mechanical effect in the treatment of obstruction of the bowels and constipation.
3. To beautify the complexion and remove freckles. In the reign of Charles II. quicksilver was taken by "the ladies of the Court" in doses of a tea-spoonful night and morning.

Large quantities of metallic mercury—a pound or more at a time—have been taken without the production of any symptoms, but should a portion become oxidized the constitutional effects of the drug would be speedily produced. The blue pill and grey powder are active from their state of minute subdivision.

The salts of mercury possess various physical as well as chemical properties, but as their pharmacological action is practically identical, it is clear that they all ultimately assume the same form in the blood.

Mercury, when applied topically to the skin in the form

of an ointment or plaster, is absorbed, passing through the epidermis without exciting inflammation. The mercurous salts are absorbed in the same way, and although they are more stimulating, they give rise to no irritation. The mercuric salts have little action on the epidermis, but when applied to the denuded skin they precipitate albumin, and if used in a concentrated form may act as caustics, and produce a slough. When taken internally they cause symptoms of gastro-enteritis from their local action.

The perchloride is one of our most powerful antiseptics, a single application of a solution of one in a thousand destroying microzymes and their spores in a few minutes. The L.G.B. (or Local Government Board) soloids, consisting of perchloride of mercury, hydrochloric acid, and aniline blue, are useful for preparing solutions for disinfecting purposes.

When mercury is absorbed into the circulation either from the skin or the stomach, it produces a train of symptoms to which we apply the term "mercurialism" or "hydrargyrism." These symptoms are as follows:—

1. There is a disagreeable metallic taste in the mouth. The gums become swollen and tender, and assume a dark red colour. The teeth feel sticky, as though their edges were glued together. The tongue swells and is covered with a thick fur, and the breath is foul.

2. "Ptyalism" or "salivation" ensues, the secretion of the saliva being increased even to the extent of one or two pints in the twenty-four hours. This salivation is due partly to reflex excitement of the glands by irritation of the tongue, and partly to stimulation of the nerves of the gland, and the gland structure itself. The glands are swollen and tender, and the saliva at first is richer than natural in epithelium and solid constituents, but after a time becomes clear and more watery.

3. Stomatitis or ulceration of the mucous membrane of the mouth comes next, and this is often very extensive. Large portions of the cheek and gums slough, the teeth fall out, and the jaw becomes carious.

4. A rash appears on the skin—*eczema mercuriale.*

5. Periostitis or inflammation of the periostium of the bones is not uncommon.

6. Mercurial erithism, a low febrile condition, accompanied by intense prostration, next ensues.

7. Profound anæmia and marasmus or wasting, accompanied by excessive purging, follows, the motions being frequent, and containing much bile.

8. Neuralgic pains in the limbs, mercurial tremor, paralysis and epileptiform convulsions are common towards the end.

Many of these symptoms are similar to those produced by syphilis. It is not to be supposed that they all occur in every case. Some people are much more readily affected than others. Ptyalism has been known to follow the administration of a grain and a half of calomel, and an eightieth of a grain of corrosive sublimate. Scrofulous patients, and people suffering from disease of the kidneys, are very susceptible to the action of mercury. Children take it well, and are not easily salivated.

When mercury is inhaled in small quantities for a length of time, as in the case of workers in quicksilver mines, barometer and thermometer makers, water guilders (who plate with gold dissolved in mercury), and looking-glass manufacturers, a somewhat different train of symptoms ensues:—

1. The body wastes, the sufferer becomes weak and anæmic, "mercurial fever" ensues, accompanied by a vesicular or pustular eruption.

2. There are "mercurial tremors," commonly known as

"shaking palsy" or the "trembles." Weakness appears usually first in the upper extremities; the voluntary movements lack their usual precision; slight tremors set in, and gradually increase both in severity and extent until the whole body is affected, the legs suffering before the trunk. The tremors are easily excited, they are uncontrollable and persist for some time. The tremulous hand can no longer be directed with precision, and after a time can scarcely convey food to the mouth. An old doctor describing the case of one of his patients says:—"He could not with both his hands carry a glass half full of wine to his mouth without spilling it, though he loved it too well to throw it away." After a time the legs are affected and begin to shake, especially at the knees, so that in walking they tremble and dance about as if they were hung on wires.

3. The skin is dry, and assumes a peculiar brownish colour.

4. There is loss of memory, which may be followed by headache, convulsions, and delirium. The speech is hurried, staccato and stammering, and in extreme cases there is disturbance of the intellect.

When the disease attains its greatest intensity the unfortunate sufferer presents a most pitiable aspect. In constant tremulous commotion, tottering, trembling, shaking, and stuttering, he is almost helpless. He can hardly walk or talk, he dare not touch any object for fear of breaking it or letting it fall, and on raising his agitated hand with food to his mouth he misses his aim and inflicts involuntary blows on his face. He must be fed and clothed like a child. Some unfortunates deprived of assistance have been known to crawl on all fours, and seize their food with the lips, like the lower animals.

In its early stage the complaint may be mistaken for

paralysis agitans or chorea, and, as the end approaches, for delirium tremens.

This complaint is not so common as it was formerly, and of late years the cases have become much less common, "water guilding" having been to a great extent superseded by electroplating. Looking-glass silvering is now carried on in large well-ventilated rooms provided with special means for preventing the diffusion of metallic particles, and the men are employed only at intervals. In the past, however, cases were of constant occurrence. A few years ago an English man-of-war received on board several tons of quicksilver saved from the wreck of a vessel near Cadiz. In consequence of the rotting of the bags, the mercury escaped, and the whole of the crew became more or less affected. In the space of three weeks 200 men were struck down by it, two died, and all the animals—cats, dogs, sheep, fowls, a canary bird, nay, even the very rats, mice, and cockroaches—were destroyed. Early in this century there occurred another instance of poisoning by mercury vapour on a still larger scale. A fire broke out in the quicksilver mines at Idria, near Trieste, and above nine hundred persons in the neighbourhood were attacked with the "trembles."

In the stomach, mercury combines with albumin, and forms an albuminate of mercury which is not soluble in water, but is readily soluble in excess of albumin and in chloride of sodium. It is absorbed in the form of a compound of mercuric oxide with albumin.

It has always been supposed that calomel increases the secretion of bile, and yet Rutherford's experiments on healthy dogs show that this is not the case. On the other hand perchloride of mercury acts as a hepatic stimulant in a very marked degree. It is possible that some of the calomel may, by the action of the gastric juice, be converted into corrosive sublimate, yet five grains of calomel subjected

for seventeen hours, at a temperature of 100° F., to the action of dilute hydrochloric acid of the same strength as the human gastric juice, yielded only $\frac{1}{35}$ grain of the perchloride. It seems more than probable that the physiological observations are right, and that the so-called clinical experience has, in this instance at least, singularly failed.

When given in small doses the perchloride increases the formation of blood corpuscles, but in large doses diminishes their number. It is an alterative, and has the power of causing absorption of fibrinous exudations.

It lessens the force of the pulse, and when applied to the frog's heart arrests its action.

It is excreted by the saliva, the bile, the urine, the sweat, and the milk.

Children are but slightly susceptible to the action of mercury, and rarely suffer from salivation, but patients with Bright's disease take it badly.

Mercury is largely employed in the treatment of syphilis. The "small dose" method is the best. The formula employed is one grain of grey powder and one grain of Dover's powder in a pill or tabloid. One should be given four times a day. There is practically no risk of ptyalism, and the treatment may be kept up for weeks or even months. The addition of the Dover's powder prevents diarrhœa. The patient may go about his work as usual, and there is no risk of catching cold. During a mercurial course, fruit, green vegetables, coffee, and aperients of all kinds should be avoided. Stimulants should be taken in the smallest quantities, and the patient should give up smoking or he will get mucous patches about the mouth and a sore throat. Some people prefer the green iodide of mercury in doses of a sixteenth of a grain.

Calomel is a useful purgative, and three grains at

bedtime made into a pill with extract of hyoscyamus will usually open the bowels freely. It is the custom in many hospitals to give every patient on admission ten grains of calomel, but this seems an unnecessarily active mode of treatment. When a well-marked action on the liver is required without violent purging, a pill containing one grain of calomel and one of euonymin will be found useful, and may be repeated at intervals during the day. A pill containing half a grain of grey powder answers equally well if repeated every three or four hours.

In many forms of infantile diarrhœa mercury is found useful, and the best plan is to dissolve a grain of the perchloride in ten ounces of water, and give the child a teaspoonful every hour. This plan of treatment is especially indicated when the motions are green in colour, slimy, and very offensive.

The perchloride is one of the most powerful antiseptics known, a one in 10,000 solution destroying micrococci and bacilli.

In the treatment of eczema, and some other chronic skin affections, preparations of mercury applied locally are useful. The following is the formula for the Unguentum Metallorum :—

Zinc ointment.
Glycerine of subacetate of lead ointment.
Dilute ointment of nitrate of mercury.

To be mixed in equal parts.

LEAD.

The chief salts of lead are the oxide, commonly known as litharge, the acetate or sugar of lead, and the subacetate.

Acetate of lead may be described as consisting of white, spongy-looking masses, made up of small interlaced acicular crystals. It has a sweetish acetous odour, and a sweet metallic taste. It is soluble in water, and effloresces slightly in the air. It is popularly supposed to be a powerful poison, but its toxic action is of a mild order, and probably an ounce might be taken without producing a fatal result. There are three preparations of acetate of lead:—

1. Pilula plumbi cum opio, pill of lead and opium.
2. Suppositoria plumbi composita, compound lead suppository.
3. Unguentum plumbi acetatis, ointment of acetate of lead.

The pills of lead and opium should not be covered with gelatine, as the lead forms with it a hard insoluble coating almost like leather.

There are also three preparations of the solution of subacetate of lead:—

1. Glycerinum plumbi subacetatis.
2. Liquor plumbi subacetatis dilutus.
3. Unguentum glycerini plumbi subacetatis.

The solution of subacetate of lead is known as Goulard water or Goulard's extract.

The soluble lead salts, when applied to raw or abraded surfaces, combine with the albumin and cover the part with an impenetrable coating which excludes the air and promotes healing. They also constringe the blood-vessels and act as sedatives, allaying inflammation. The lead salts are unirritating, and never excite congestion.

Acetate of lead is not nearly such an active poison as is commonly supposed, and would-be suicides not infrequently recover after taking an ounce. Some years ago, by accident, thirty pounds of this drug were mixed at a miller's with eighty sacks of flour, and the whole was made into bread

and distributed in the usual way to customers. Five hundred people were attacked with symptoms of poisoning, and although they suffered from a dry burning sensation in the throat, thirst, vomiting, colic, and cramps in the legs, in not a single case did it prove fatal.

Lead may be absorbed by the skin in sufficient quantity to produce the constitutional symptoms of the drug.

Lead salts act as astringents to the mucous membrane of the mouth, and are partly converted into albuminates. In the stomach the same process is continued, but large doses act as irritants and excite vomiting. Most of the drug is absorbed by the mucous membrane of the stomach in the form of the albuminate. Any portion which escapes absorption acts in the intestines as an astringent, and is then converted into sulphide of lead, an insoluble and inert compound.

When lead is absorbed in small quantities for a length of time it produces a train of symptoms to which the term "plumbism" or "saturnism" is applied.

From the manifold uses of this metal, lead poisoning is of common occurrence. The modes in which it may be introduced in the system are as follows:—

1. Occupations.

(1) *House painters* often suffer from lead poisoning from want of care in washing the hands before taking food. In grinding the carbonate, which is largely used as a basis for paints, the fine particles are often inhaled in sufficient quantity to produce lead poisoning. Sleeping in freshly painted rooms has been known to produce it.

(2) *Potters* who use lead for glazing purposes are frequent sufferers. It is not common, at all events in England, amongst lead miners.

(3) *Compositors* often suffer from handling the type, type-metal containing lead.

(4) *Barmen* suffer from handling and cleaning pewter pots.

(5) *Card players* suffer from the lead glaze on cards, especially if they moisten the fingers in the mouth in dealing.

(6) *File cutters* suffer from the dust which results from the files being "bedded" in lead whilst being nicked.

(7) *Electric light workers* are often victims. The plates are made from red lead and nitric acid.

(8) *Japanners* suffer from the japanned articles being brushed over with colours containing lead, and from the dust produced in the process.

(9) *Enamellers* suffer in the same way, the dust containing lead and a little arsenic.

2. Articles of Food.

(1) Farinaceous foods wrapped in lead are unsafe. Tinned vegetables, fish, shell-fish, and meat are especially open to suspicion. The aliments usually most heavily loaded with lead are those rich in fatty matters, such as sardines preserved in oil. I know of one case in which well-marked symptoms of chronic lead poisoning were apparently due to the prolonged use of a popular essence of meat put up in tins.

(2) *Pickles*, when the jars or bottles are capped with leaden tops, are very injurious.

(3) *Loaf Sugar* sometimes contains lead from the moulds in which the sugar is set being painted with white lead, a portion being mechanically taken up.

(4) *Snuff.*—Snuff may be adulterated with red lead, or may be rendered unsafe from being wrapped in leaden covers.

3. Articles of Drink.

(1) *Water.*—Drinking water often becomes contaminated with the lead dissolved from lead pipes and the lining of cisterns. Pure water and water containing carbonic acid, carbonate of lime, or sulphate of lime, have little or no action on lead. Carbonic acid indeed acts as a protective, by covering the lead with a fine insoluble film of the carbonate. Water containing much oxygen, nitrites, nitrates, chlorides, and especially organic matter, acts quickly on lead. Even a very small quantity—as little as $\frac{1}{50}$ gr. in a gallon—may suffice to produce lead poisoning. Water containing $\frac{1}{20}$ gr. to the gallon should be rejected as unsafe.

The chemical tests for lead are very delicate, and it is by no means difficult to find a grain of lead in 10,000 parts of water. Dr. Wilson Hake, of the Westminster Hospital, who is an authority on such matters, tells me that, with care, and the adoption of certain precautions, it is possible to detect one part in a million.

It has long been known that the use of moorland water often gives rise to lead poisoning. It is probable that the water is rendered acid by vegetable decomposition, and readily acts on the lead of the pipes or cisterns with which it comes in contact.

(2) *Wine* is sometimes sweetened with acetate of lead, and has produced lead poisoning. Bottles are sometimes cleaned with shot, and if these are accidentally left in the bottle the wine may become contaminated.

The celebrated epidemic of colic in Poitou was traced to the use of lead to prevent the wine of the country from turning sour, the injurious effect of the metal not being at that time recognized.

Acetic, citric, tartaric, and malic acids all act with various degrees of solvency on lead.

(3) *Spirits.*—Rum stored in leaden tanks on board ship has caused lead poisoning in sailors.

(4) *Cider* made in glazed earthenware vessels may prove injurious. Some years ago an inquiry was instituted into what was known as "Devonshire Colic." It was found that it occurred exclusively in cider drinkers, and by a careful process of elimination, it was discovered that it was due to the admixture of lead with the cider, either designedly with the view of sweetening it, or to the inadvertent employment of lead in the construction of the cider mills and vats.

(5) *Lemonade* and *Soda Water* may produce lead poisoning when patent siphon tops are used.

(6) *Beer* is often contaminated by the lead pipes, and people who take the first glass in the morning are especially sufferers.

(7) *Milk* which is sour readily becomes impregnated with lead.

(8) *Tea* packed in lead is equally liable to produce lead poisoning.

4. Medicines.

Lead given medicinally has been known to excite chronic lead poisoning, but it is of comparatively rare occurrence from this cause, and the acetate is often given in five grain doses three times a day for weeks, or even months, to check diarrhœa or hæmorrhage, without producing bad effects.

5. Articles of Apparel.

(1) Lead in the lining of hats has produced symptoms of lead poisoning.

(2) Brussels lace is often whitened with preparations of lead.

6. Dyes and Cosmetics.

(1) *Hair Dyes* are a constant source of lead poisoning. Some time ago twenty-one specimens of hair dye were analyzed, and of these fourteen were found to be practically identical in composition. They nearly all contained lead and sulphur; the percentage of lead being highest in those which were warranted to be harmless, and to be free from injurious substances. The following is the most common formula:—

Acetate of lead	90 grs.
Precipitated sulphur	3 drs.
Glycerine	10 „
Heliotrope perfume	2 „
Water	to 10 ozs.

It is, of course, an easy matter to substitute some other perfume or combination of perfumes for the heliotrope.

Allen's "World's Hair Restorer" is said to contain in an eight ounce bottle, 75½ grains of sulphur, and 87 grains of acetate of lead.

(2) *Cosmetics* containing lead have proved injurious to actors, actresses, and professional beauties.

In many cases cattle have suffered from lead poisoning whilst grazing in the proximity of smelting furnaces. Dogs have suffered from drinking water trickling from lead works, and birds frequently die from eating berries on which have been deposited particles of oxide of lead from the forges.

The old-fashioned wafer was often coloured red with lead, a circumstance which was utilized by a well-known novelist in the elaboration of a plot in which slow poisoning was the main incident. The old brick-red penny postage-stamps would have answered his purpose equally well, for they contained lead, and were responsible for many cases of chronic lead poisoning.

From time to time well-marked cases of lead poisoning are met with in which the most careful investigation fails to disclose the source of introduction.

There can be no doubt that some people are much more susceptible to the action of lead than others, and it has even been said that the susceptibility runs in families. One lady suffered from lead poisoning from sleeping a single night in a room which had been recently painted, whilst another suffered from colic and wrist drop from driving past some lead works.

The first effects are usually slow, obscure, and insidious, and are easily confounded with those of other debilitating agents.

SYMPTOMS.

(1) *Cachexia.*—One of the earliest symptoms of plumbism is cachexia. There is a general feeling of ill health, and nutrition is not maintained. An anæmic condition is soon developed, and the skin acquires a dull earthy hue. There is a marked diminution in the number of the red blood corpuscles, and a slight increase in the number of the white ones.

(2) *Blue Line on the Gums.*—The blue line is observed at the edge of the gums where they join the teeth. It is one of the first symptoms to appear, and the slowest to disappear. It is always most marked opposite the incisors. It is absent when there are no teeth, and is most marked in people who fail to clean their teeth. Sometimes it extends to the whole of the gums, and even to the contiguous portions of the cheek. It is produced by the sulphuretted-hydrogen developed from the tartar of the teeth penetrating the gums and forming a black sulphide with the lead.

(3) *Colic.* "*Lead Colic.*" "*Painter's Colic.*"—This is a tearing pain, usually referred to the region of the umbilicus.

At one time it raged like an epidemic in a portion of our fleet, from the accidental impregnation of the rum with lead, and was called by sailors the "West Indian belly-ache." The abdominal walls are retracted and rigid, and the pain is usually relieved by pressure, but not always. It is probably due to irregular contraction of the involuntary muscular tissue of the intestines. It is often accompanied by obstinate constipation and impairment of digestion.

(4) *Cramps.*—There are often cramps in the calves of the legs, sometimes in the penis and scrotum, or in women in the uterus. There may be pains in the joints, especially of the extremities, often simulating rheumatism and aggravated by cold and wet weather.

(5) *Lead Paralysis or "Wrist Drop."*—Usually of the extensors of the forearm, especially those muscles supplied by the posterior interosseous branch of the musculo-spiral nerve. The supinator longus, which is supplied by a branch of the musculo-spiral nerve before it divides into the posterior interosseous and the radial, escapes. This affords a point of diagnosis between paralysis from lead poisoning and paralysis from disease of the musculo-spiral nerve. If this muscle is not paralyzed it shows that the disease is not limited to the posterior interosseous nerve, and that the disease is probably not due to lead poisoning. The condition of the supinator longus is tested in this way:—"Extend the paralyzed forearm on the table with the radius upwards, then press down the wrist and tell the patient to raise it from the table. The supinator longus, if not paralyzed, becomes hard, contracted, and stands out firmly." In lead paralysis the muscles of the ball of the thumb waste, and in severe cases the deltoid, and even the muscles of the neck and trunk are similarly affected. General paralysis may occur. As a rule there is only loss of motor power, but there may be loss of sensation. The

muscles, post-mortem, are found to be greyish-red in colour, or whitish and tough, with considerable increase in the interstical connective tissue. The origin of the disease is probably in the spinal cord, and is due to hyperæmia and proliferation of the neuroglia with consequent contraction, causing degeneration of the cellular elements.

(6) *Nervous Phenomena.*—Of the cerebral symptoms to which the term *saturnine encephalopathies* has been applied, epileptiform convulsions are the most common. They are usually preceded by intense headache, vertigo, and dimness of vision. They may occur early, and usually come on quite suddenly. The convulsions which ensue later are associated with an albuminous condition of the urine. These cerebral symptoms have been attributed to the presence of lead in the tissues of the brain, and it has been pointed out that lead-saturated cells would be incapable of high function. On the other hand, it is not improbable that the convulsions are not unconnected with the changes which take place in the substance of the kidney.

(7) *Abortion.*—Lead is a prolific cause of abortion, and women working in lead frequently suffer in this way. The father may cause abortion even when the woman is not a lead worker. The wives of lead workers frequently suffer when they wash the husband's clothes.

Lead can easily be detected in the urine of sufferers from lead poisoning.

Post-mortem, the chief morbid changes are met with in the liver and kidneys. The paralytic symptoms are partly due to neuritis, which is most marked in the intra-muscular twigs, is less marked in the larger nerve-trunks, and is usually absent in the parts near the nerve roots.

Gout is due to an accumulation of uric acid in the blood, and lead in people predisposed to this disease may produce an attack. Lead undoubtedly diminishes the excretion of

uric acid, and the case is recorded of a gouty subject who, on taking a few doses of acetate of lead and opium for a chronic diarrhœa, was seized with an acute attack of joint pain.

Treatment of Lead Poisoning.

(1) Blue pill. Saline draught.

(2) A mixture of sulphate of magnesium, sulphate of iron, dilute sulphuric acid, spirits of chloroform and peppermint water, three times a day for four days. Tincture of belladonna may be added if there is much colic.

(3) A course of iodide of potassium to eliminate the drug. Should iodide of potassium depress the patient, iodide of sodium may be substituted. It is not generally known that the bromides are just as efficacious as the iodides in their power of eliminating lead from the system.

(4) Good diet, with tonics, cod liver oil, extract of malt, chemical food, and syrup of hypophosphites.

(5) Warm baths, Turkish baths, shampooing, massage.

(6) Electricity, the Faradic or continuous current being employed.

(7) Hypodermic injections of strychnine in doses of a twentieth of a grain twice or three times a week.

No treatment for the cure of lead poisoning is likely to prove of much avail unless the origin of the mischief can be detected and the introduction of the drug stopped.

Prophylactic measures are of the utmost importance, and are strictly enforced in all properly conducted establishments in which lead is used.

The workrooms should be thoroughly ventilated, and extraction shafts should be erected to carry off lead dust or vapour containing lead.

Respirators should be provided, and their use insisted on when necessary.

Proper lavatory accommodation should be provided, so that the hands and face may be washed before leaving the factory.

The workpeople should change their outer garments before going home.

Meals should never be taken in the workrooms, and no person should be allowed to begin work without having partaken of a substantial meal.

Warm baths should be taken frequently, and accommodation should be provided for the purpose.

A medical officer should be retained, and he should examine every worker at least once a week.

A supply of treacle beer should be kept in some easily available spot, and the workers should be encouraged to take it freely. It may be made according to the following formula—

Treacle	15 lbs.
Bruised ginger	½ lb.
Water	12 galls.
Yeast	1 qt.
Bicarbonate of soda	1½ ozs.
Sulphuric acid	1½ ozs.
Tincture of capsicum	2 drs.

Boil the ginger in two gallons of water; add the treacle, stirring it in well, and then the remainder of the water hot. Put it in a barrel with the yeast and the capsicum. When the fermentation is nearly complete add the sulphuric acid mixed with eight times its bulk of water, and lastly the soda dissolved in a quart of water. Let it stand for three days, when it is ready for use.

Acetate of lead is employed to check hæmorrhages of all kinds, whether the bleeding is from the lungs, the

stomach, the intestines, or other parts. It is usually given in a mixture in five-grain doses, often in conjunction with acetic acid and acetate of morphine.

TARTARATED ANTIMONY.

This is the substance known as tartar emetic. It is called "tartarated" antimony, because it is a tartrate of antimony and potassium. Another example of a tartarate is the tartarated iron, which is a tartrate of iron and potassium. There are two preparations of tartar emetic :—

1. Vinum antimoniale, or antimonial wine.
2. Unguentum antimonii tartarati, or ointment of tartarated antimony. The strength of the wine is two grains to the ounce.

The ointment, when rubbed into the skin, produces a rash which is at first papular, then vesicular, and finally pustular. It closely resembles the rash of small-pox, and often leaves scars. This ointment, under the name of "pox salve," was at one time largely employed as a counter-irritant in cases of meningitis and mental disturbance. The effects were often very severe when applied freely to the scalp. Perforation has been recorded of both lamellæ of the parietal bones as the result of the necrosis induced by the application.

When tartar emetic is given in small doses, it produces some diminution in the force of the pulse, and an increase in perspiration.

When the dose is larger the symptoms are prolonged nausea violent retching and vomiting, with muscular relaxation and general weakness. The saliva is increased in quantity, and the skin is covered with sweat.

In toxic doses all the symptoms are greatly intensified. The vomiting is violent, repeated, continuous, and is

accompanied with colicky pain in the stomach. The vomited matter consists first of mucus, then of mucus and bile, and finally of mucus and bile mixed with blood. Purging is a prominent symptom, the stools resembling those of cholera. There are cramps in the extremities, and there is well-marked exhaustion. This is followed by symptoms of collapse, the pulse being thready or hardly perceptible, the countenance is livid, pinched, and anxious, the voice is weak or suppressed, the temperature falls, and the skin is covered with cold clammy sweat. Taken internally it may produce a pustular rash on the skin like the eruption of small-pox, and both vesicles and pustules have been noticed on the mucous membrane of the mouth, throat, and œsophagus. These spots may be due to the direct contact on the drug, but it is worth noting that the favourite site of the eruption is on the genitals and the inner surfaces of the thighs. Antimony, even in large doses, unlike arsenic, never causes suppression of the urine.

Tartar emetic excites vomiting even when the stomach has been excised and replaced by a bladder. This was thought to prove that it acted directly on the vomiting centre in the medulla, but it is not conclusive, as it may be excreted by the œsophagus or intestines, and act reflexly through them on the centre. It is probable that the action is direct on the vomiting centre, but the evidence is incomplete.

In the lower animals, tartar emetic produces paralysis of the motor and sensory nerves, with loss of reflex action. Antimony, like arsenic, destroys the functions of all the organs of the body in the order of their vital endowments. It acts not only on the sensory and motor nerves, but on the cord and even on the muscles. It is a general protoplasmic poison, destroying the functions of all the nitrogenous tissues. It weakens the heart in this way, and acts as a general depressant. It acts even on the skin, rendering it

in frogs soft and gelatinous so that it can be scraped off readily.

It is eliminated partly by the kidneys, partly by the bile, and partly by the liver. A portion is retained in the body. It increases the elimination both of urea and carbonic acid, and to a smaller extent of uric acid and pigments.

The antimonial wine is a fairly good diaphoretic, and may be given with advantage in the early stages of phthisis, when febrile symptoms are well marked. The following mixture is used in these cases:—

Carbonate of ammonium	2 drs.
Antimonial wine	24 mins.
Water	to 8 ozs.

Two table-spoonfuls are taken every four hours with one table-spoonful of—

Citric acid	160 grs.
Water	to 4 ozs.

In small doses tartar emetic is useful in the dyspnœa of young children due to a commencing attack of bronchitis. A grain is dissolved in half a pint of water, and of this a tea-spoonful is given every ten minutes for the first hour, and subsequently hourly until relief is obtained.

ARSENIOUS ACID.

The substance commonly called arsenic in arsenious acid or white arsenic.

There is one preparation, liquor arsenicalis or Fowler's solution, a mixed solution of arsenite and carbonate of potassium coloured with compound tincture of lavender. It is a one per cent. solution, and is alkaline in reaction. The colour is due to the red sandal wood, contained in compound tincture of lavender.

There is one preparation of arseniate of sodium, the liquor sodii arseniatis, also a one per cent. solution.

A popular preparation is Donovan's solution, liquor arsenii et hydrargyri iodidi, a combination of mercury, arsenic and iodine.

Arsenic is fatal to many of the lower forms of animal life, but does not check fermentation.

It produces no change in the unbroken skin, but when applied to wounds or sores excites active inflammation. In frogs it has a peculiar effect on the skin, producing degeneration and partial solution of the protoplasm of the cells.

Arsenic is absorbed by the stomach, though probably not in the form of an albuminate. It excites a feeling of warmth at the pit of the stomach, and improves the appetite.

After absorption into the blood arsenic appears to modify tissue change.

Arsenic in frogs paralyzes first sensation and reflex action, and then voluntary power. It is a general protoplasmic poison, destroying the functional activity, first of the central nervous system, next of the sensory and motor nerves, and finally of the muscles. It speedily arrests the action of the heart by affecting all its structures—ganglia, nerves, and muscle. It lowers arterial tension in mammalia, partly by its action on the heart, and partly through its influence on the vaso-motor nerves.

Small doses of arsenic are very fatal to frogs, a thirty-thousandth of the weight of the animal producing complete paralysis, and an eighty-thousandth proving fatal in three days.

The prolonged use of arsenic has in pigs and fowls the same effect as phosphorus. The bones become more compact, and the heart, liver, and spleen undergo fatty degeneration.

In man tolerance is soon established. In some parts of Lower Austria, in Styria, and especially in the hill country towards Hungary, people take arsenic as a condiment or sweetmeat. The drug is known by the name of *nidri*, and is sold to the people by itinerant pedlars and herbalists. The men eat it to improve the wind and enable them to climb the mountains, whilst the women take it to improve their looks and because the men do. In some places the experiment is performed for the edification of visitors, the investigator being invited to bring his own arsenic and recover it from the urine. The effect on the men is astonishing. They at once feel invigorated, and easily ascend mountains which at other times they could not surmount without much difficulty and distress of breathing. The quantity to commence with varies with the age and physical condition, but never exceeds half a grain. The dose is taken on alternate days before breakfast, and the quantity is increased as tolerance is established. No unpleasant symptoms result if the established rules are observed. If, however, the custom is discontinued considerable inconvenience is experienced, so that a return to the practice is necessitated.

It is well known that arsenic is given to horses to improve the sleekness and condition of their coats. Either a pinch is sprinkled among the oats or a piece the size of a pea is wrapped in linen and tied to the bit. When once a horse gets accustomed to arsenic he suffers if he is deprived of it, becoming low spirited and incapable of exertion.

Very serious effects are sometimes produced by the use of arsenic in wall-papers and articles of domestic use. "It is an unquestionable fact that the natural health is suffering from the use of arsenic and other poisons in the manufacture of domestic fabrics to an extent not yet fully appreciated by the public, notwithstanding that from time to time the

injurious effects have been pointed out by numerous medical and chemical authorities, whose attention has been given to the question" (Carr, "Our Domestic Poisons"). Arsenic is not only used in the manufacture of wall-papers, but is also found in candles, carpets, advertisement cards, playing cards, ornaments for children's toys, indiarubber balls, dolls, japanned goods, venetian blinds, floor-cloth, bookbindings, artificial leaves and flowers, violet powder, sweets, hat linings, and gloves, and a number of other substances. My colleague, Dr. Wilson Hake, has found arsenic in large quantities in the green paper wrapper of a well-known brand of cigarettes. The fact of a wall-paper being marked "non-arsenical" is no proof that it is free from arsenic. Carr says:—"A paper selected by the writer marked 'non-arsenical' was found, after being hung, to be highly arsenical, and this from a first-class London firm of the highest respectability." Emerald green, which is a compound of arsenic and copper, is extensively employed in the manufacture of various kinds of wall-papers. Some years ago a manufacturer boasted that he never used less than two tons a week. Arsenic has frequently been detected in the dust on books, picture-frames, and the furniture of rooms so papered, and the workmen who handle these papers not infrequently suffer from arsenical poisoning. It is not only the green papers which are dangerous, for arsenic in various combinations is used in a great variety of colours, and even in French white. In Germany the use of arsenic in the preparation of wall-papers was long since prohibited under a heavy penalty. In England arsenic is not so largely employed for the purpose as formerly, and one or two of our makers have established a world-wide reputation for wall-papers which will bear the most careful scrutiny with regard to their freedom from this deadly drug.

The symptoms of chronic arsenical poisoning are faintness,

great depression, nausea and vomiting, purging, a sense of constriction in the œsophagus, coryza, cough, wasting, and hæmoptysis. These symptoms are here tabulated according to the parts affected, and the frequency of their occurrence:—

(1) *Stomach and Bowels.*—Diarrhœa and dysentery, pain in abdomen, nausea and vomiting, loss of appetite, thirst.

(2) *The Eyes.*—Conjunctivitis and sore lids.

(3) *The Nervous System.*—Depression of spirits, restlessness, sleeplessness, nightmare, and headache.

(4) *The Throat, Nose, and Respiratory Organs.*—Soreness of throat, ulceration and dryness, bronchial catarrh, asthma, symptoms resembling ordinary cold in the head with much running of tears, spitting of blood accompanied with progressive loss of flesh.

It should be remembered that, in cases of chronic or slow arsenical poisoning, the symptoms often very closely resemble those of chronic gastritis or ulceration of the stomach.

The arsenic may be introduced into the lungs as a fine dust or in the form of arsenuretted hydrogen gas.

Chronic arsenical poisoning is often mistaken for phthisis. A rash may appear on the skin, which may assume the form of eczema or urticaria, and the hair and nails sometimes fall off.

Arsenic is eliminated from the body by the kidneys, the intestines, and perhaps by the liver. It can be detected in the bones long after all traces have disappeared from the viscera.

The celebrated "aqua tofana," used by Hieronyma Spara, the presidentess of a society whose diversion it was to poison their own and other women's husbands, was made by rubbing white arsenic into pork and collecting the fluid which drained from it when exposed for some days to the heat of the sun. It was a very active poison which defied

detection by chemical investigation, and probably consisted of a mixture of arsenites of cadaverine putrescine and other unknown ptomaines.

Therapeutically arsenic is a very valuable remedy. In large doses it is given with success in the treatment of asthma. Arsenical cigarettes are smoked with advantage, not only to relieve the dyspnœa of asthma, but in cases of chronic bronchitis. Small doses of arsenic frequently repeated afford relief in cases of persistent sneezing accompanied by a profuse discharge of watery fluid from the eyes and nostrils. These small doses are also useful in irritative dyspepsia, when the tongue is furred and its papillæ are red and prominent. Arsenic is especially useful in that form of dyspepsia in which, in consequence of the exaggerated peristaltic action of the stomach and intestines, the patient has an evacuation of the bowels immediately on taking food. Large doses of arsenic are useful in psoriasis and nearly all scaly skin diseases. The addition of a hundredth of a grain of arsenious acid to the sulphate of iron pill increases its efficacy in the treatment of anæmia.

BISMUTH.

The most important salts of bismuth are the carbonate, subnitrate, and the citrate.

There is no preparation of the carbonate, but of the subnitrate there is a lozenge—trochiscus bismuth. Of the citrate there is one preparation, the liquor bismuthi et ammonii citratis, the therapeutical value of which is open to question.

The carbonate and subnitrate when applied to the skin act as sedatives, and under the name of Spanish white or pearl white are largely used as cosmetics. The only

objection to their use is that they are apt to turn black when brought in contact with sulphuretted-hydrogen or the fumes of gas.

The carbonate and subnitrate are both insoluble, and are apt to cause a sensation of roughness in the mouth and to blacken the tongue.

They are as sedatives to the mucous membrane of the stomach, and probably act mechanically rather than chemically. Possibly a small quantity may be rendered soluble by the acid secretion of the stomach. The greater part of the salt passes into the intestines unaltered, and acts as a sedative and slight astringent. Any constitutional effects produced are probably due to contamination with arsenic. The dose of the carbonate usually administered is too small, and in cases of diarrhœa a drachm or more may be given with advantage.

Some people on taking bismuth suffer from what is called "bismuth breath." This is not observed in every case, but in a certain proportion of cases an odour like that of garlic is produced. What this is due to is not very clear. It has been customary to attribute it to the presence of arsenic, traces of which are found in most specimens of bismuth; but in some cases in which it has been very pronounced the bismuth has been examined for arsenic and none has been found. It is probably due to the presence of a minute trace of tellurium. The case is recorded of a student who took a dose of tellurium experimentally, and whose breath became so offensive that he had to sit apart from his fellow-students during the remainder of the session.

Bismuth is eliminated with the fæces, and stains the motions a dark slate colour.

Bismuth is of much value in gastric ulcer and in all painful affections of the stomach. It probably acts mechanically. It should always be given on an empty

stomach, and is usually suspended in a mixture by mucilage of acacia or mucilage of tragacanth. It promptly relieves the nausea and vomiting due to irritation of the stomach. The general experience is that the carbonate or subnitrate is much more useful than the liquor.

IRON.

The carbonate is official under the name ferri carbonas saccharata or saccharated carbonate of iron. There are two official preparations—the mistura ferri composita and the pilula ferri carbonatis. The mixture is known as Griffiths' mixture, after Dr. Moses Griffiths who flourished in the last century. The only other official mixture containing iron is the mistura ferri aromatica or Heberden's ink. The pills are known as Griffiths' pills.

The sulphate exists in three forms, the sulphate, the dried sulphate, and the granular sulphate. The dried sulphate, which contains no water of crystallization, is useful for making pills. Five grains of the dried sulphate are equivalent to nine grains of the ordinary sulphate. Blaud's pills are not official, but are largely used in the treatment of anæmia. They consist of equal parts of the sulphate and carbonate of iron, with powdered tragacanth. A double decomposition takes place, carbonate of iron and sulphate of potash being formed. The therapeutic action of sulphate of potassium in this dose is practically nil. Blaud's pills simply afford a convenient mode in which to administer freshly-prepared carbonate of iron. The carbonate is a ferrous salt insoluble in water, unirritating and not astringent. The presence of the sugar prevents it from being converted into ferric oxide. These pills are prescribed in mild cases of anæmia. They are extensively advertised, but their

popularity is in excess of their merits. They are sold as a patent preparation in some countries, and are often incorrectly described in text-books as "Bland's pills." They are not nearly so useful as a pill made with dried sulphate of iron and a drop or two of simple syrup. This last formula is not popular with chemists, as it requires some skill to make the pills. They are easy enough to make when you know how.

An excellent combination in cases of anæmia is the following:—

Dried sulphate of iron	3 grs.
Arsenious acid	$\frac{1}{100}$ gr.
Simple syrup	$\frac{1}{2}$ gr.

To make a pill. One should be taken three times a day after meals.

It is essential that these pills should be made up with syrup and with syrup alone. If they are made up with extract of belladonna or extract of gentian, the sticky mass adheres to one portion of the mucous membrane of the stomach, and the result is that the patient suffers intense pain and not unfrequently developes symptoms of ulceration of the stomach. If they are made up with simple syrup the mass disintegrates at once, and is distributed throughout the contents of the stomach in a form in which it can be readily absorbed.

The perchloride of iron is met with as the liquor ferri perchloridi or strong solution of perchloride of iron, of which there are two preparations, the tinctura ferri perchloridi and the liquor ferri perchloridi. The tincture and the liquor are of the same strength, but the latter is commonly employed in hospital practice from motives of economy.

The ammonio-citrate is a scale preparation, and there is one preparation of it, the vinum ferri citratis. There

are three scale preparations of iron—tartarated iron, citrate of iron and ammonia, and citrate of iron and quinine. They cannot well be mistaken for anything else, with the exception, perhaps, of sulphate of berberia.

Dialyzed iron occurs in the form of the solution, liquor ferri dialysatus. It consists of a highly basic ferric oxychloride, from which most of the acidulous matter has been removed by dialysis. The process of dialysis was discovered by Graham in 1861. It consists of separating crystallizable substances from those which do not crystallize by pouring a mixture of both on a porous diaphragm, the under surface of which is in contact with water. The substances which pass through the septum are called "crystalloids," from their power of forming crystals, whilst those which remain upon the diaphragm are called "colloids," from their resemblance to gelatine, and because they do not crystallize. One of the most convenient dialyzing agents is parchment paper, prepared by immersing unsized paper in sulphuric acid.

Some salts of iron are inorganic, whilst others are organic. Of the inorganic salts some are ferrous, whilst others are ferric. The inorganic salts are more astringent than the organic, whilst the ferric salts are more astringent than the ferrous. Various albuminates of iron have recently been employed with much success. "Ferratin," an iron derivative of acid albumin discovered by Schmiedeberg and Marfori of Strassburg, is one of the best.

Iron is a constant and necessary constituent of the body, and may be regarded as a food rather than a medicine. It forms an important constituent of the hæmoglobin of the blood.

None of the preparations of iron applied to the skin produce any change, but the astringent preparations, if applied to abraded surfaces, act as stimulants, or irritants,

coagulating the albumin, and constringing the blood-vessels. They are astringents and styptics.

The soluble salts of iron have a metallic taste, and act as astringents to the mouth. They are not used as topical applications to the mouth, as they stain the teeth and tongue black from the formation of a sulphide with the sulphuretted-hydrogen arising from decayed teeth and offensive breath.

The astringent preparations, such as the perchloride, act as stimulants and irritants to the mucous membrane of the mouth, whilst the non-astringent preparations exert little or no action. The soluble salts of iron combine with albumin in the stomach, forming soluble ferrous and ferric compounds and albuminates, which, although insoluble in water, dissolve readily in the acid gastric juice. The insoluble salts are dissolved to a variable extent by acid solutions. Some of the iron is absorbed from the stomach, but much of it passes into the intestines, where it is converted into an insoluble sulphide.

After absorption into the blood, iron increases the number of blood corpuscles and the percentage of hæmoglobin contained in them. This effect is much more marked in anæmia, where the proportion of the red corpuscles is deficient, than in health. A little free iron may be detected in the blood [illegible]. Oxidation in the tissues is increased, together with the functional activity of the various organs.

[illegible] however, is so small that a dog, on being [illegible] of iron daily, excretes with the urine [illegible] of iron more than he does on a pure [illegible]

[illegible] much of the beneficial action of iron [illegible] to its influence on the mucous [illegible] an explanation which accords [illegible] experience that the astringent

preparations are much more useful than those which are bland and unirritating.

One of the chief therapeutical uses of iron is as a hæmatinic.

When injected hypodermically iron produces in frogs first excitement and then paralysis of the central nervous system. In mammals it causes paralysis both of sensation and motion. The blood pressure falls from paralysis of the vaso-motor nerves, principally of the intestine. Its action in this respect is similar to that of arsenic, antimony, and some other drugs.

Iron is eliminated chiefly by the fæces, which it stains black, a very small quantity sufficing for this purpose. Even when iron is injected into the circulation it is eliminated by the intestines. It exerts no action on the biliary or pancreatic secretions. Some of the iron is eliminated by the kidneys, and can be detected in the urine by the usual reagents, especially sulphide of ammonium, a proof, apart from the therapeutical action of the drug, that some of it is absorbed.

The therapeutical uses of the various preparations of iron have already been sufficiently indicated. There are many people who declare that they "cannot take iron," and it is undoubtedly the case that many patients on taking preparations of iron in unusually large doses, or for a prolonged period, suffer from disturbance of digestion, diminution of appetite, gastric oppression, and even vomiting. In rare cases hæmorrhage from the mucous membranes has been noted, and in the case of delicate anæmic women the eruption of a crop of acne spots on the face, breasts, and back is not uncommon. The blackening of the teeth is more likely to occur when they are carious, the sulphuretted hydrogen precipitating the iron in the form of the sulphide from the solution in which it is held by the alkaline

secretions of the mouth. Even when the teeth are perfectly sound blackening may still occur from the presence of tannic acid in various articles of food, and in tea and other drinks, the precipitate in this case being a tannate and not a sulphide of iron.

[redacted]

PHARMACOLOGY

OF

SYNTHETICAL COMPOUNDS.

ALCOHOL.

THE most important alcohols are:—

CH_4O. Methylic alcohol, wood spirit.
C_2H_6O. Ethylic alcohol, spirits of wine.
C_3H_8O. Propylic alcohol.
$C_5H_{12}O$. Amylic alcohol, fusel oil or potato spirit.

Rectified Spirit is ethylic alcohol with 16 per cent. of water, *i.e.* it contains 84 per cent. of alcohol. It is the product of the vinous fermentation of sugar contained in wine, malt liquours, etc. These when distilled yield brandy, rum, etc., and when redistilled rectified spirit. By the distillation of a fermented liquor a mixture of alcohol and water containing as little as 10 per cent. of water can be obtained, but this mixture cannot be separated by further distillation, as the two liquids go over together in these proportions without further division.

Proof Spirit contains 49·24 per cent. of absolute alcohol, so that it is practically half spirit and half water. Every half per cent. of alcohol over this corresponds to one degree over proof. The strength of spirits of wine was formerly tested by moistening gunpowder with it and setting fire to the spirit. If the powder went off the spirit was said to be "over-proof," but if it contained too much water to do this it was said to be "under proof."

Absolute Alcohol, or ethylic alcohol, is made from rectified spirit by redistilling it with dry potassic carbonate, but in order to dry it completely it ought finally to be mixed

in a retort with its own weight of quick lime in lumps, and after standing for some days again distilled. The first portions collected contain the moisture of the apparatus and should be rejected. Alcohol mixes with water in all proportions, and the mixture occupies a smaller bulk than the alcohol and water occupied previous to mixing.

Methylic Alcohol is one of the products of the dry distillation of wood. The watery liquid is separated from the tar and distilled, and after being purified is redistilled.

Methylated Spirit is spirit mixed with 10 per cent. of wood spirit.

In the British Pharmacopœia the Spiritus vini gallici or French brandy and Vinum Xericum are official. In the United States Pharmacopœia in addition to brandy, whisky (Spiritus frumenti), white wine (Vinum album, 10 to 12 per cent. of alcohol), stronger white wine (Vinum album fortius, 20 to 25 per cent. of alcohol), red wine (Vinum rubrum), Cologne water (Spiritus odoratus), and bay rum (Spiritus myrciæ) are official.

The mistura spiritus vini gallici of the British Pharmacopœia contains yolk of egg, sugar, cinnamon water, and brandy. Although not often prescribed it is a useful preparation, taken in two-ounce doses at eleven o'clock in the morning, for patients suffering from advanced phthisis. The American "egg-nog," which has a somewhat similar composition, is made with one egg, one table-spoonful of white sugar, one table-spoonful of water, one table-spoonful of milk, and one table-spoonful of brandy, whisky or white wine. Beat the white of the egg to a froth, then beat in the sugar, next the yolk, then the milk, next the wine or spirit, and finally the water. Why in the English preparation the white of egg should be rejected is not obvious.

Wines and spirits contain in addition to alcohol, water and salts and various volatile ethers and flavouring agents.

The following table shows the percentage of alcohol contained in the common varieties:—

Rum	60 to 70 per cent.
Brandy	50 to 60 ,,
Whisky	50 to 60 ,,
Gin	49 to 60 ,,
Port	20 ,,
Sherry	15 to 19 ,,
Burgundy	13 to 14 ,,
Claret	10 to 17 ,,
Hock	8 to 10 ,,
Champagne	6 to 13 ,,
Strong ale	6 ,,
Stout	6 ,,
Porter	4 ,,
Small beer	1 ,,
Teetotal drinks	6 to 14 ,,

It is easy enough to estimate the amount of absolute alcohol contained in a draught of any alcoholic drink.

For example, half a pint of beer is ten ounces, and the alcoholic strength of ordinary beer is five per cent.; in other words, in one hundred ounces of beer there are five ounces of absolute alcohol.

$$100 : 5 :: 10 : x.$$
$$100x = 50$$
$$x = 0{\cdot}5, \text{ or half an ounce of alcohol.}$$

Again, an average glass of sherry contains two and a half ounces, and the strength of sherry is about fifteen per cent. In two glasses of sherry we have—

$$100 : 15 :: 5 : x.$$
$$100x = 75$$
$$x = {\cdot}75, \text{ or three-quarters of an ounce.}$$

A glass of gin contains two and a half ounces, and the

average strength of gin is fifty per cent., so that a glass contains—

$$100 : 60 :: 2{\cdot}5 : x.$$
$$100x = 150{\cdot}0$$
$$x = 1{\cdot}5, \text{ or an ounce and a half of absolute alcohol.}$$

A pint of champagne contains about fifteen ounces, and taking its alcoholic strength at ten per cent. we have—

$$100 : 10 :: 15 : x.$$
$$100x = 150$$
$$x = 1{\cdot}5, \text{ or an ounce and a half}$$

of absolute alcohol, or the equivalent of a glass of gin.

Liqueurs are generally supposed to be innocuous, but they contain a large percentage of alcohol, and although the dose is small they are saccharine, and the combination of alcohol and sugar is especially injurious. The most popular liqueurs are Chartreuse (green and yellow, the former being much stronger), Curaçoa (which is improved by diluting it with liqueur brandy), Maraschino, Kümmel, and Benedictine. They are usually taken in small quantities at the conclusion of dinner, and often in conjunction with coffee. It is only minor poets who can afford to breakfast off devilled prawns and a tumblerful of green chartreuse. Probably the least injurious of liqueurs is dry gin, which although strong in alcohol contains practically no sugar.

Alcohol is largely used in pharmacy, especially in the preparation of tinctures.

Rectified spirit is employed when the active portion of the drug from which the tincture is made is sparingly soluble in more dilute alcohol; for example, aconite, arnica, asafœtida, benzoin, nux vomica, etc.

Proof spirit is used when the active ingredients are partly soluble in spirit and partly soluble in water.

Some tinctures are made with aromatic spirits of ammonia, which from its alkaline reaction is a suitable solvent for resinous matters. We have examples in the ammoniated tinctures of guiacum, valerian, and opium.

Some years ago the temperance party thought it wrong to use tinctures made with alcohol, and ordered glycerine to be substituted for the spirit. The new tinctures were all right, except that in the majority of cases they contained none of the activity of the plant.

The physiological action of alcohol presents many points of interest.

When alcohol is applied to the skin and allowed to evaporate it contracts the blood-vessels locally and produces a sensation of cold. This property is taken advantage of by the surgeon, who employs evaporating lotions composed largely of spirit as an application to inflamed tissues. A common formula for an evaporating lotion is two and a half ounces of rectified spirit to half a pint of water.

When alcohol is applied to the skin in a concentrated form it thickens and hardens the epidermis. It is a well-known custom to rub the buttocks of bed-ridden patients with brandy or eau-de-Cologne to prevent the formation of bedsores.

Alcohol coagulates albuminous solutions by withdrawing water. When alcohol is taken into the mouth it forms with the secretions a thin layer of coagulated albumin. It also acts as an astringent to the mucous membrane, and is useful in checking bleeding from the gums and in promoting the healing of small ulcers. In the stomach it excites a feeling of warmth, accompanied by increased vascularity and increased secretion. This affords an explanation of the common custom of taking gin and bitters before meals, or a glass of sherry at the commencement of dinner. Almost all "bitters" are made of gentian. The gentian improves

the appetite, and the alcohol, by increasing the secretion of gastric juice, provides the means for digesting the food. Alcohol also assists in the expulsion of flatus from the stomach, an action which is familiar to us in the relief afforded by various cordials in cases of colic and allied conditions. When the alcohol is taken habitually in excess it gives rise to chronic gastric catarrh, so that the patient suffers from nausea and vomiting in the early morning before breakfast.

In the intestines alcohol acts as an astringent, and port wine is with many people a favourite remedy for a slight attack of diarrhœa. When, however, alcohol is taken too freely it stimulates the secretions, and habitual topers are rarely constipated. In the case of the light French wines which are of little alcoholic strength, and are usually consumed in fairly large quantities, the presence of various salts in solution probably accounts for the laxative action.

In the blood alcohol forms a compound with hæmoglobin, which takes up and gives off oxygen less readily than hæmoglobin itself. Alcohol lessens the oxidizing power of the blood and diminishes waste. It is diffused uniformly throughout the body, except that the blood usually contains a higher percentage than the organs.

After an alcoholic debauch the specific gravity of the urine is sometimes lower than that of water.

Alcohol is in great part split up into carbonic acid and water, but a small portion is eliminated unchanged with the urine and by the lungs. The peculiar and characteristic odour of the breath of chronic alcoholics is well known.

Alcohol has a marked effect on the circulation. It stimulates the heart's action and dilates the superficial blood-vessels. The veins are dilated, and the blood passes so quickly through the vessels that it has no time to become venous. This effect on the circulation explains the flushing

of the face which follows the administering of alcohol, and also the throbbing feeling in the head and to a less extent all over the body which is so often experienced. The temperature falls because a larger surface of blood is exposed to the surrounding atmosphere.

Alcohol also induces sweating, and this may have something to do with the fall of the temperature. In large doses the diminished tissue change is an important factor. Every one knows that Arctic travellers and others exposed to intense cold should not take alcohol. The effect would be to dilate the superficial blood-vessels and bring down the temperature of the body. If, however, a person who has become chilled takes a glass of hot brandy and water as soon as he gets home, it proves beneficial by dilating the blood-vessels in an atmosphere considerably warmer than that to which he has been exposed. When a person is suffering temporarily from the effects of an over-dose of alcohol, as, for example, a visit to the Docks, he may materially improve his condition by lying for a couple of hours in a very hot bath. The common explanation is that "it sweats the drink out of him," but probably what really happens is, that the superficial blood-vessels are dilated so that the alcohol in the body is distributed over a wider area, and is applied less freely to the central nervous system.

The effect of alcohol on the nervous system is very marked, the highest centres being first affected. To begin with, the imagination is excited, and the person loses his habitual timidity and self-consciousness. The nervous shy man finds himself talking freely to his fair neighbour at dinner, and doing his best to make himself agreeable. In ordinary society, when ladies are present, the effect of alcohol is not carried beyond this stage. At a large public dinner, however, rather more wine is taken, and the diffident speaker suddenly finds himself on his legs returning thanks

with great fluency for the guests of the evening. He may be making a fool of himself, but he is oblivious of the fact. At a man's dinner, when there is less restraint, the dose of alcohol is often carried to the extent of impairing the judgment. He tells his host the amount of his income, blabs about some African shares which are worth picking up and are likely to go better, and, being a respectable married man, suggests that they should go to the Empire or take a stroll down Piccadilly.

Up to this point no particular harm is done, and all that can be said of the patient is that he "has been dining," but if he goes a little further his emotions are excited, and he invites casual acquaintances to come and stay with him for a week. He is now in a maudlin condition, and is generally said to be "a little bit on." After this the downward course is rapid. His motor centres get affected, and he finds some difficulty in articulating, especially when he endeavours to remark that it is a truly rural view. Then the cerebellum comes into play, and he experiences the delights of "seeing double," accompanied by a sensation that the pavement might have been made wider with advantage. A policeman puts him into a cab, but he is unable to give his address, and probably spends the rest of the night in the police-station. If not looked after he falls into a state of somnolence and insensibility, the respiratory centre suffers, and he becomes comatose, or "dead drunk." Still with care he is safe, but if left exposed to the cold night-air, or not properly looked after, the heart's action becomes weakened and he dies.

Alcohol possesses the valuable property of dulling the sensibility of the vaso-motor centre to reflex impressions, so that there is an almost complete absence of shock from an accident or injury received whilst in this condition. It is often said that Providence watches over

drunken men, and this is the physiological explanation of it.

Alcohol is said to be an aphrodisiac. It increases the desire, but diminishes the facility of execution.

When alcohol is habitually taken in excess it induces a train of symptoms to which we apply the term "Alcoholism." This condition is the result of a more or less continuous use of alcohol, and differs from the immediate effects of a considerable overdose, to which we apply the term intoxication or drunkenness. Alcoholism is met with in several forms:—

1. Chronic Alcoholism.
2. Acute Alcoholism, or Delirium Tremens.
3. Alcoholic Mania.
4. Acute Melancholia.
5. Oinomania.

The causes of Alcoholism are:—

1. *Hereditary Predisposition.* There can be no doubt that a tendency to alcoholism is, in a certain sense, hereditary. It is not the disease itself which is handed down from generation to generation, but there is an inherited weakness of the nervous system. We not infrequently find that of the children of intemperate people some are drunkards, some are idiots, some are hysterical, whilst others suffer from epilepsy, persistent neuralgia, or some other form of nervous disturbance. It is sometimes difficult to distinguish between the influence of example and the effect of hereditary predisposition, but the latter factor must always be taken into consideration.

2. *Occupation.* This is one of the most potent predisposing causes in the production of alcoholism. We find examples of it in wine merchants, potmen, brewers' draymen, waiters, butlers, and gentlemen's servants. The drayman drinks more beer than is good for him, because he is allowed

so many gallons a day, and it does not cost him anything. The butler takes too much because he has the key of the cellar, and thinks it his duty to "sample" the bins. The commercial traveller drinks to excess because if he were to decline the "friendly glass" he would get no orders; whilst the reporter, and hack literary man, finds that without whisky the press would be kept waiting, and he would break faith with his paper or publisher. There are some occupations which almost compel a man to be abstemious. For example, a tight-rope dancer, or an acrobat has to keep pretty steady, or an accident soon puts an end to his career. A big singer, too, has to be careful about what he eats and drinks, or his voice soon goes off. Even the billiard player suffers, and fails to score, if he indulges too freely.

3. *Bad Ventilation.* If there is one thing more than another which induces a craving for alcohol, it is faulty ventilation. Ill-ventilated theatres, dining-rooms, ball-rooms, close offices, and workshops are directly answerable for much alcoholic excess. Every one knows how much whisky people take at a smoking concert, where the air is as a rule especially vitiated, and what terribly bad heads they have in the morning.

4. *Poverty* is one of the most powerful predisposing causes of drink. Poverty means a great deal; it means absence of sufficient food, food of poor quality, badly cooked and ill-served; it means dirty, ill-ventilated rooms, old clothes, absence of recreation and amusement, and, above all, perpetual anxiety. A man in this condition will often drink when he is unable to eat.

5. *Monotony* soon leads to a craving for alcohol. One dreary day follows another, and there is nothing to look forward to. People with a small income, "just enough to live on," are the chief victims. More people get drunk on Sunday than any other day in the week from the absence

of amusement and occupation. Some people have a great liking for alcohol, a liking which almost amounts to a "craving," and monotony intensifies it.

6. *Hysteria* in its manifold forms readily develops a predisposition for drink. This condition is common in women who lead dull monotonous lives, and who have no occupation, and no means of gratifying their desires.

7. *Chronic Illnesses*, especially of the painful kind, are often associated with alcoholism. It is common enough in women who suffer from neuralgia.

8. *Venereal Excesses* often lead to a craving for alcohol. This is very marked in newly married men of delicate constitution. It usually passes off in a few months.

9. *Bad Wines*. One of the most important factors in the production of chronic alcoholism is the custom of drinking wines of inferior quality. The rich man who can command old vintage wines, and spirits which have been matured by age, can consume with impunity a much larger quantity of alcohol than the man who has to be content with eighteenpenny claret, and champagne at half a crown a pint. When the wine is good a healthy man, even after exceeding considerably, should experience no other effect than that of pure stimulation. When the wine or spirit contains fusel oil, he will have a bad headache in the morning, congestion of the cerebral blood-vessels, general depression, and a decided incapacity for mental exertion.

The exciting causes of alcoholism hardly come into play in the case of the chronic forms, but an acute attack is often induced by a debauch. It is often said that suddenly cutting off drink in those accustomed to it, will induce an attack of delirium tremens, but there is no evidence that this is the case. It is true that sometimes a drayman is brought into the hospital suffering from the effects of an accident, and if he is given nothing to drink he rapidly becomes

acutely delirious; but probably this is traumatic delirium, and not true delirium tremens. It is said that the onset of an attack of delirium tremens is often determined by a Turkish bath, and that bleeding will induce the symptoms.

The symptoms of alcoholism are most conveniently studied under the different varieties of the complaint.

Chronic Alcoholism is the commonest form, and the one we meet with daily in ordinary society. It is not drunkenness or intoxication which leads to this condition, but the habit of constantly imbibing alcoholic liquors, especially when very little exercise is taken. The earliest symptom is dyspepsia and loss of appetite, especially for breakfast. This is speedily followed by "morning vomiting" and retching, often excited by the act of cleaning the teeth. This symptom should always excite suspicion, and the woman who complains of "morning vomiting" is either alcoholic or she is pregnant, or, at all events, suffers from some uterine disturbance. In the case of a man, morning vomiting practically always means alcohol. The vomited matter usually consists of a clear acid fluid, unmixed with food. It is not uncommon to find that both husband and wife suffer from vomiting in the morning, he from the effects of alcohol, and she as the result of pregnancy. The vomiting takes place simultaneously, the one exciting the other. The next symptom is marked by tremor of the hands, and the patient notices that he is very "shaky"; the handwriting in the morning is tremulous, and the words are not written with the facility with which they are formed later in the day. After a time the tremor extends to the legs, and there is a little want of co-ordination, so that the patient gets into the way of going downstairs carefully, and is cautious in stepping off the curb into the roadway. The tremor at this stage is not very marked, and is easily

controlled by an effort of the will. After a time the patient gets restless at night, and complains of noises in the ears and floating specs before the eyes. From time to time he experiences attacks of giddiness, which are not sufficiently serious to make him catch hold of the railings in the street, but are serious enough to make him feel for the moment very uncomfortable. The patient suffers from neuritis, or possibly from some joint affection, or some irregular form of paralysis. Then a certain change takes place in the mental condition, which usually assumes the form of indecision. The patient, for example, stands for a long time on the curb hesitating to cross the street, or he calls a cab, and then, when the man draws up, shakes his head as if he did not want him. Another form of mental change is the curious tendency exhibited by alcoholics to tell lies. It is not that they wish to deceive people, but out of a substratum of truth they elaborate a story which fails to bear investigation. The patient's personal appearance, little by little, undergoes a change. He may get fat—and this is commonly the case with beer drinkers—or he may get thin, but in any case the face gets bloated, the eyes lose their brightness, the conjunctivæ become congested, and there is a generally unhealthy appearance which is characteristic enough to the practised observer. The muscles get flabby, there is a disinclination for physical exertion, and the patient sweats profusely on the slightest provocation. After a time he suffers from piles, or may have to seek relief for diarrhœa. The disinclination for food becomes pronounced, and soon morning vomiting and persistent retching are added to the list of troubles. The soles of the feet get tender, and it is not uncommon for old drunkards to go about in their slippers the greater part of the morning. Finally the patient gets cirrhosis of the liver, and, much against his will, has to seek the advice of a doctor.

Delirium Tremens.—This condition is so well known that it hardly requires a detailed description. The symptoms usually come on suddenly. The patient is confused in his head, and exhibits every indication of alarm. His tongue is dirty, and the secretions from the skin, stomach, and intestines are offensive. There is complete loss of appetite, and no solid food is retained. The patient is unable to sleep, and suffers from delusions and illusions of all kinds. He is constantly talking, addressing either those about him, or other people whom he imagines to be present. He talks about his business, or rambles incoherently from one subject to another. He may be recalled to his senses for a moment, but soon relapses into his previous condition of incoherence. He has distinct illusions, and sees all kinds of animals, such as cats, dogs, rats, mice, and black-beetles, crawling over the paper of the room, or running over his bedclothes. He endeavours to get out of bed, and protests loudly when restrained. He may be under the impression that he is illegally detained, and in his paroxysm of alarm may strike his attendants. The face is flushed, the skin is moist, the urine is scanty and of high specific gravity, and the temperature is 102° F. or more.

This condition lasts for a day or two, and then, under appropriate treatment, passes away. After a month or so, unless there is a complete change in the mode of life, there is another attack. The fresh paroxysm may not be due to any particular excess, but may result from business, worry, or anxiety, or possibly even from some little episode which causes excitement or loss of temper. Sometimes these people get epileptoid convulsions and die suddenly.

Alcoholic Mania.—Sometimes patients pass out of an acute attack of delirium tremens into this condition, but they may suffer from this form directly and without any previous attack of delirium tremens, and even without any

previous gastric disturbance. It is especially likely to occur in people with some hereditary predisposition to insanity. The patient is apt to become homicidal, and the prognosis is bad.

Acute Melancholia.—Occasionally alcoholism assumes this form. The patient ceases to take an interest in anything. He suffers from delusions, such as, for example, that he has lost all his money, that he is going to the workhouse, that he has committed some unnatural offence, or that his wife is unfaithful. These people do not differ from ordinary melancholiacs. There is often a tendency to suicide, and the prognosis is distinctly bad.

Oinomania.—This is one of the most painful forms of alcoholism, and is apt to occur in men of considerable natural ability. For example, a man is the recognized leader of his party in the House of Commons. He is a good business man and a fluent speaker. To the ordinary observer he is a total abstainer. For weeks together he abstains from alcohol entirely, and then, without a moment's warning, comes a sudden outburst. It matters to him nothing what he has to do or what his engagements are. He suddenly goes off to Whitechapel, spends every penny he has in his pocket, pawns his watch and rings, or gives them away to his companions, and is rescued after many days in a state of nudity and hopeless intoxication. He is brought home, spends twenty-four hours in bed, and quietly resumes his work without explanation, and apparently in a condition of complete oblivion as to all that has happened.

In the treatment of chronic alcoholism it is doubtful if drugs do much good. Some benefit may be derived from such drugs as tincture of perchloride of iron, or from acids and nux vomica, or from certain combinations, such as the syrup of the hypophosphites; but much more reliance should be placed on constant occupation, a fair amount of

amusement, good cooking, and, above all, an object in life, such as a judicious and sympathetic woman. Men are much more amenable to treatment than members of the other sex.

Although the injurious effects of alcohol on the different organs of the body are usually ascribed to the presence of amylic alcohol or fusel oil, it is only fair to point out that people who habitually get drunk on "faints" do not appear to experience any very injurious consequences. It may be as well, perhaps, to explain that the liquor known by this name is the final portion of the distillate obtained on rectifying crude spirits of wine from fermentated potatoes and other kinds of starch. It has the odour of bad spirits, and is rich in alcohols which are less volatile than ordinary alcohol and ether. It consists of fusel oil, that is, amylic alcohol, mixed with large quantities of the secondary and primary propyl alcohols and the higher homologues of the alcohols and ethers. It is of such little value that at many distilleries it can be obtained in large quantities for nothing. The intoxicating effect is followed by a period of intense depression. It would naturally be assumed that this coarse and immature spirit would act very prejudicially on the liver and other organs, and yet Dr. James Swain, of Bristol, records the case of a man, aged 57, who had been in the habit of getting drunk on it all the days of his life, and who, strange to say, at the autopsy exhibited nowhere any greater degeneration of organ or tissue than might have been expected in the case of any hard working man of his age. His liver weighed sixty ounces, and presented no sign of cirrhosis. There was nothing characteristic observed at the post-mortem examination, except that the body and all the organs exhaled a powerful odour resembling that of nitrite of amyl, but somewhat sweeter. A consideration of this case must make us hesitate to ascribe all the dangers

of habitual alcoholic excess to the presence of a trace of fusel oil. In fact some people might go so far as to say that, apart from its disagreeable odour, amylic alcohol was, after all, the safest of intoxicants.

ANÆSTHETICS.

This is a name—originally proposed by Dr. Oliver Wendell Holmes—given to a series of agents employed for the prevention of pain, and applied especially to those used in surgical practice. Anæsthetics are divided into—

I. General Anæsthetics.
II. Local Anæsthetics.

The chief general anæsthetics are:—

1. Chloroform.
2. Ether.
3. Nitrous oxide.
4. Ethidene.
5. "A.C.E." mixture.

The local anæsthetics are:—

1. Ether.
2. Bromide of ethyl.
3. Ice.
4. Cocaine.

Carbolic acid applied to the skin will produce temporary local anæsthesia, and so will many of the essential oils. Menthol, thymol, oil of peppermint, and oil of cloves are useful applications in the treatment of neuralgia. Aconitine is used in the treatment of many painful affections, but not for the performance of surgical operations.

The history of the discovery of anæsthetics is a curious one.

In 1798 Mr. Humphry Davy, then 22 years of age, published his "Researches, Chemical and Philosophical, chiefly concerning Nitrous Oxide," in which he says, "As nitrous oxide in its extensive operation appears capable of destroying physical pain, it may probably be used with advantage during surgical operations."

No notice was taken of this, but for many years subsequently the inhalation of nitrous oxide was a favourite experiment with itinerant lecturers on chemistry.

In 1844 Mr. Colton delivered a popular lecture on "Laughing Gas" at Hartford, Connecticut. In the audience was Mr. Horace Wells, an enterprising dentist of that city. He noticed that people under the influence of the gas did not hurt themselves when they fell. The following morning he had one of his own teeth extracted under gas administered by Mr. Colton. During the following three weeks Wells extracted teeth from fifteen people under the influence of gas. Wells went to Boston to demonstrate his method at the Medical College. The gas was administered for the extraction of a tooth, but the patient cried out, and Wells was denounced as an impostor and a fraud.

For many years ether was used for the relief of spasmodic asthma and the dyspnœa of phthisis and other diseases of the chest. In the "Journal of Science and Arts," published at the Royal Institution, the following appeared in 1818, and has since been attributed to Faraday:—"When the vapour of ether mixed with common air is inhaled it produces effects very similar to those occasioned by nitrous oxide." No notice was taken of this.

Some years later we find that ether was commonly used in what were called "Ether frolics." In 1842 a certain Dr. Long, of South Carolina, becoming acquainted with the effects produced by ether, induced a Mr. Venable to inhale the gas whilst he removed a tumour from his neck. The

only record he made of the operation was in his ledger, and the entry is to this effect:—

"James Venable, 1842; ether and excising tumour, \$2."

He operated on three other people between 1842 and 1845, but refrained from publishing his discovery.

Wells, during his unlucky visit to Boston in 1844, had talked over the matter with Dr. Morton, a rough, energetic dentist, and with Dr. Charles Jackson, a quiet, scientific dentist. In 1846 Morton tried ether on himself, and remained insensible for eight minutes. Instantly, as he tells us, he looked for an opportunity of giving it to a patient, and a stout, healthy man coming in just at the critical moment, he induced him to inhale, rendered him quite insensible, and drew one of his teeth without causing the slightest pain. A month later Morton gave ether to a patient in a hospital, and a tumour was removed with complete success.

Some years later Simpson, of Edinburgh, suggested the employment of anæsthetics in childbirth, and substituted chloroform for ether.

The subsequent history of the men who introduced anæsthetics is instructive—and encouraging.

Wells, after his failure at Boston, went home disheartened, and was long ill and unable to practise his profession. He gave up dentistry and went in for picture dealing. He tried to get some reward for the priority of discovery, but was constantly disappointed, and finally *committed suicide.* Twenty years after his statue was set up at Hartford, and five years later, his widow being destitute, a subscription was raised on her behalf.

Long lived quietly and little known till 1878, when he died. *He received no reward or honour of any kind.*

Morton, after taking out his patent, had many lawsuits

and disputes. He petitioned Congress for some grant or reward, and after waiting for twenty-two years, *committed suicide* by drowning.

Jackson was equally unsuccessful in his endeavours to obtain recognition, and finally *ended his days in a lunatic asylum.*

Simpson was made a baronet, had a statue erected to him in Edinburgh, and a bust in Westminster Abbey.

Such is the history of the discovery of anæsthetics.

I. CHLOROFORM.

Chloroform, the formula for which is $CHCl_3$, is made by the action of chlorine on alcohol.

It is a liquid; colourless, having a smell which is agreeable, fruity, and ethereal; a taste which is pungent and sweet; a specific gravity of from 1·48 to 1·496, and a boiling-point of 140° F. It is neutral in reaction, slightly soluble in water, and mixes with alcohol and ether in all proportions.

It dissolves indiarubber, gutta-percha, many resins, fats, and alkaloids, and is decomposed by potash and soda.

It should not be made from methylated spirit, and when poured on blotting-paper should leave no unpleasant smell.

It was first used as an anæsthetic in 1847, by Dr. Simpson, afterwards Sir James Y. Simpson.

Chloroform, when applied to the skin, evaporates rapidly, and leaves a feeling of cold. When the evaporation is prevented it passes through the epidermis, and produces a burning sensation, the skin is reddened, and if the application is prolonged there may be vesication. The counter-irritation produced by chloroform is utilized in many painful affections. The chloroform poultice, made by

sprinkling chloroform on a pad of lint, will check the pain of lumbago, and is useful if applied to the abdomen in cases of colic. The patient is told to keep it on as long as he can bear the smarting, and then to shift its position.

In the mouth chloroform stimulates the mucous membrane and increases the flow of saliva. When swallowed in small quantities it increases and co-ordinates the movement of the stomach and intestines, expelling flatus and relieving the pain of colic. In attacks of vomiting or indigestion with flatulence, a common remedy is three drops of chloroform in a wine-glass of water. In large doses it produces gastro-enteritis, and ultimately, as it becomes absorbed, gives rise to much the same symptoms as if it were inhaled. It is often swallowed by lunatics for suicidal purposes. When a large quantity has been taken, the characteristic smell of the drug is noticed in the breath. The patient usually presents an anxious appearance, and complains of a burning pain in the throat, stomach, and bowels. There is coldness of the extremities, with staggering gait. There may be vomiting, but the patient soon becomes insensible, and passes into a condition of coma with complete anæsthesia, dilated pupils and stertorous breathing. From one to two ounces usually prove fatal.

Chloroform, whether absorbed from the stomach or the lungs, has a marked influence on the nervous system. It paralyzes the nervous centres in much the same order that alcohol does; but with this difference, that in the case of chloroform, there is not that preliminary stage of excitement which is such a prominent feature in the case of alcohol. One of the first effects of chloroform is to abolish sensation and voluntary motion. If it would do no more than that it would be a boon, although the work of the surgeon would be frequently interrupted, and often marred by involuntary struggles on the part of the patient. But,

fortunately, the spinal cord is also subdued, and the reflex functions of the cerebro-spinal axis are abolished so far as concerns the voluntary muscles, which are rendered passive. The centres concerned in respiration remain active, and the same is the case with the sympathetic ganglia of the heart.

Chloroform derives its utility as an anæsthetic from the fact that the respiratory centre is the last of all the parts of the central nervous system to be deprived of activity.

This view of the physiological action of chloroform would not receive universal acceptance. For many years there has been a great discussion as to whether it is the heart or the respiration which first goes wrong in cases of death from the use of chloroform as an anæsthetic. The Edinburgh rule is practically, "Watch the respiration; the heart will take care of itself." The scientific commission appointed by the Nizam of Hyderabad to investigate the question adopted this view, but the subsequent researches of MacWilliam, Gaskell, and others, show that the verdict of the commission cannot be taken as conclusive. There is very little doubt that chloroform may paralyze the heart without first affecting the respiration, and, moreover, that the paralysis of the vaso-motor centre, and the consequent withdrawal of blood from the heart and brain to the dilated splanchnic area, may be an important factor in bringing about a fatal result. Stewart suggests that, in addition to the "Edinburgh Law," a second should be added, to this effect:—"Watch the breathing; watch the pulse. If the heart threatens to fail for want of blood, fill it by raising the legs and compressing the abdomen."

Chloroform undoubtedly exerts a powerfully depressing action on the heart. When injected into the jugular vein it instantly arrests the heart's action and destroys its muscular irritability. The vapour of chloroform applied to the exposed heart paralyzes it, and even when artificial

respiration is maintained, the effect is very apparent. There can be no doubt that chloroform destroys the contractile power of the heart-muscle.

A good proof that chloroform exerts a depressing action on the frog's heart, is afforded by a series of experiments made by Ringer with Roy's apparatus. The ventricle was attached to the cannula by a ligature passing round the groove between the auricles and the ventricles. The portion of the heart employed—the ventricle with a little of the groove—is free from inhibitory nerves or ganglia, so that the influence of the drug cannot be due to any action on the inhibitory apparatus. Chloroform, it was found, acts like lactic acid, muscarine, and pilocarpine, in reducing the height and duration of the tracing until the heart stops in diastole. The addition of ammonia at once strengthens the heart and restores its action, but a larger dose of chloroform again arrests it, in spite of the presence of the ammonia. Atropine does not antagonize the action of the chloroform, and even when atropine is added first, the chloroform still exerts its characteristic action.

Chloroform was at one time extensively employed as an anæsthetic. It was said that it could be given with equal safety to men and women, to children a few days old, and to centenarians. Pregnancy was held to be no bar to its administration, and a condition of collapse was not regarded as a reason for withholding its administration. It was held that the action of the drug on the brain and on the cardiac ganglia, through the medium of the vagus and sympathetic, protected the heart from the indirect effects of external violence and diminished the risk from shock on the operating table. It revolutionized the old rule to defer operation till collapse had passed off. It eliminated the risk of secondary hæmorrhage, as, from the absence of faintness during the operation, the vessels which required ligature declared

themselves by bleeding. It was said that any person who was in a fit condition to undergo a severe operation was in a fit state to take chloroform. Of late, however, these views have undergone some modification, and chloroform is not the popular anæsthetic it was some years ago. There is one thing in its favour, and that is, that it can be given to children with perfect safety.

In private practice surgeons usually prefer operation early in the morning, and this is a decided advantage to the anæsthetist, for the patient has had no food since the previous night, is fortified by a good rest, is already in bed, and in a mental condition favourable for the production of anæsthesia. There are one or two precautions the anæsthetist always takes. He sees that false teeth are removed, and that there is no impediment to the full expansion of the chest by stays or tight clothing.

The view now almost universally held by the most experienced observers is that chloroform is not a safe anæsthetic. A well-known surgeon said to me, "I never use it except for children or for tongue cases, and then I take care that the patient is never fully under." An equally well-known physiologist said, "When I was working with monkeys I lost a large proportion of them from chloroform, although they were healthy animals. On opening the thorax I always found that the heart had come to a standstill."

There can be no doubt that the popularity of chloroform, as an anæsthetic, in this country is on the wane. The mortality from its employment is increasing, despite the care devoted in the medical schools to the matter of instruction in its use. The drawbacks of ether administration are as nothing compared with the greater risk of fatal results undeniably associated with the administration of chloroform.

Chloroform may, perhaps, be all right in India, where

ether cannot be given, the small number of deaths from chloroform amongst the natives being probably explicable, first, on the ground that the vapour is not readily given in a concentrated form, and secondly, that they are somewhat insusceptible to its action.

The rule with regard to the administration of chloroform in the case of adults seems to be not to give it at all; but, if it must given, to avoid all forms of apparatus, and to let the patient inhale from a pocket-handkerchief, so that the vapour is diluted as much as possible.

There are several kinds of apparatus sold for the administration of chloroform, the intention being to afford some guarantee that the proportion of chloroform vapour to air does not exceed four per cent. In many cases, however, no apparatus of any kind is available, and the anæsthetic is given from a napkin or pocket-handkerchief; in fact, in Scotland this method is almost universally followed. Probably more depends on the choice of a pure chloroform than on the apparatus by which it is given.

The sensation of inhaling chloroform is on the whole a pleasant one. Many people acquire a great liking for it. Some people dislike it, partly because it produces a choking or suffocating feeling, and partly because, as they say, they dislike to have their senses taken away.

After a few whiffs the patient experiences noises in the ears and lights before the eyes, with a feeling of weight or oppression at the chest. The heart seems to be beating wildly, and there is throbbing in the big blood-vessels. In this early stage there may be hysterical symptoms, especially in women, the patient laughing or crying or perhaps screaming. The pulse is usually a little quickened at first from nervousness, but it soon falls in frequency and gains in force.

In a short time all discomfort ceases, the patient becomes

quiet, breathes calmly, and is evidently happy and comfortable. Consciousness is distinctly affected, for, whilst questions are evidently still heard, their purport is not understood, and the answers are returned slowly and are not relevant. After a time there may be a period of excitement during which the patient struggles and attempts to get up; but this soon passes away, and the muscles, which before were contracted, soon assume a condition of flaccidity.

At last the patient becomes completely insensible. Reflex action is lost, and pain is no longer experienced. The pupils are contracted, and the limbs when raised fall heavily. The signs of danger are:—(1) the breathing becoming stertorous or shallow; (2) the pupils dilating suddenly; or (3) the heart showing signs of failure.

In cases of danger from the over-administration of chloroform prompt measures must be taken. The tongue should be pulled out with the forceps. The doors and windows should be opened wide, so as to ensure a current of fresh air. The chest and face should be flapped with a wet towel, and, above all, artificial respiration should be commenced at once. The head should be lowered, and the extremities should be raised. A succession of quick, sharp blows over the thorax will sometimes stimulate the heart to action. The artificial respiration should be kept up steadily for some time, and a bystander, watch in hand, should see that the movements are not performed faster than twenty in a minute.

It must be remembered that at a certain stage of chloroform anæsthesia, women often exhibit marked signs of sexual excitement, and on their recovery it is not uncommon for them to bring charges of improper conduct against the bystanders. It is never safe to give a woman an anæsthetic without the presence of a third person. The

patient has no intention of bringing a false charge, but believes that impropriety actually took place.

Under the influence of chloroform and other anæsthetics, patients often make use of bad language, a custom from which women are by no means exempt. A young lady of seventeen, brought up in the seclusion of a country parsonage, will, when under chloroform, burst out with a torrent of oaths that would make a London cabby turn blue with envy. It is customary to say that the swearing is one of the symptoms of the drug.

In some instances a patient may have to be maintained under the influence of chloroform for a prolonged period—for hours, or days, or possibly weeks. This has been done in the case of digital treatment of subclavian and other aneurysius. It presents no difficulty, for when once the patient is under the influence of the drug, a very few whiffs from time to time will keep him quiet. He might be roused sufficiently from time to time to take liquid food, or he might be fed by the rectum.

Patients have often been taken from London to Brighton under the influence of chloroform, and it is quite conceivable that, if necessary, they might be conveyed across the Atlantic in a state of insensibility.

The mortality from the administration of chloroform is comparatively high, and it is not unnatural that many patients look forward with a feeling of considerable dread to taking this anæsthetic. The question of the choice of an anæsthetic is a serious one, and the question has even been discussed as to who is to decide the point. Dr. Dudley Buxton thinks the anæsthetist. He says:—"Sometimes a patient refuses one anæsthetic, preferring another. Here the administrator clearly cannot shrink responsibility, but must give that agent which he deems best, without regard to the whim of the patient." Here I entirely differ from Dr.

Buxton. I think the patient is the person to decide the question, that is, of course, if he is in a condition of mind to be consulted. If a patient came to me and said he wanted chloroform for an operation, I should point out to him that ether was preferable, but I should always recognize the fact that the ultimate decision rested with him. If I wrote to my stockbroker and told him to buy me African Mining Shares, I should not be pleased if he invested the money in Consols, even if they were safer. There is sometimes a special reason, personal to the patient, for selecting one anæsthetic in preference to another. Take the case of a young married woman for example. She may have heard that people talk pretty freely under the influence of ether, and knowing that her husband will insist on being present at the operation, she promptly decides on chloroform, being willing to take the increased chance of a fatal termination to the risk of saying something indiscreet in the presence of other people. It is inconvenient to rave about "dear Charley" when your husband's name is Edward. The lady knows best, and I should certainly respect her wishes in the choice of an anæsthetic.

Chloroform has a good many uses besides its employment as an anæsthetic in surgical operations. It is largely used in parturition. Some people object to its employment on ethical grounds, believing that a woman should bring forth her children in pain and sorrow. They hold this view when they are not in the family way, but when it comes to the actual pinch they generally arrive at the conclusion that just a little whiff would do no harm. The quantity of chloroform needed in these cases is very small, and there is no possible advantage in pushing it. A little vapour is inhaled, and the patient sinks into a quiet sleep. Her sensibility to pain is decreased, but the uterine contractions go on as well as ever. On medical grounds there is no possible objection to the

use of chloroform in these cases. It does not predispose to inflammation, post-partum hæmorrhage, or puerperal convulsions, and in addition to the relief from pain which it affords, it is distinctly beneficial in relaxing the maternal passages. Then again, chloroform is often given to relax spasm with the view of reducing dislocations and herniæ. It is often given, too, as an aid to diagnosis, especially in suspected disease of the abdominal organs, and in cases of malingering. It is used in the treatment of convulsions, in fits of all kinds, and it is inhaled with advantage to allay the paroxysms of cough in whooping-cough, asthma, and phthisis. The vapour of chloroform played on the raw surface of an ulcer, or on large superficial burns, often relieves pain. A few drops placed in the hand and held close to the eye relieves photophobia. Mixed with lard in the proportion of half a drachm to the ounce, it allays itching arising from urticaria or lichen.

II. ETHER.

Ether, or sulphuric ether $(C_2H_5)_2O$, is made by the action of sulphuric acid on alcohol. It is a liquid, volatile, having a fragrant odour, a hot taste, and a specific gravity of 0·735. It is very inflammable, boils at 105° F., and evaporates without residue.

This is not the substance used to produce anæsthesia.

For anæsthetic purposes we use pure ether, the æther purus of the British Pharmacopœia, which has a specific gravity of 0·720. It is given pure, and without the admixture of atmospheric air.

An ounce is poured into a cone, which may be made of sponge, leather, or pasteboard. It may be dipped into hot

water to warm it, if the weather is cold. It may have an indiarubber bag attached to the apex of the cone, so as to diminish waste.

As ether sometimes produces irritation of the larynx, and as the smell of ether is objectionable to some people, it is a good plan to give nitrous oxide-gas first, and then to follow it up with ether. A simple apparatus has been designed to enable the administrator to give first nitrous oxide, and then ether, without removing the mouthpiece. This, in the opinion of many administrators, is the best combination of anæsthetics which has yet been devised.

Etherization by the rectum has been suggested, but is best left alone. I have heard of a case, although I have not seen any published account, of a patient in private practice who was to be operated for some slight laryngeal trouble. He was a man in good health, and it was determined to resort to rectal etherization. Soon after the commencement of the administration, the intestines became distended, the abdomen became tympanitic, and there was a profuse discharge of clear watery fluid from the lungs. The patient died within an hour, practically on the operating table. There was a post-mortem examination, at which it was found that the lungs were œdematous, and that the mucous membrane of the intestines was markedly congested. I do not know what treatment was adopted, but a hypodermic injection of atropine would have checked the excessive secretion, and possibly saved the patient's life. The administration of anæsthetics by the rectum seems to be undesirable, at all events when ether is employed.

Ether is less suitable than chloroform as an anæsthetic for children.

Ether is not a good anæsthetic for people who suffer from bronchitis.

Ether is unsuited for operations by gas or candlelight, or

when the actual cautery is employed, as the vapour is inflammable.

Ether makes people drunk, and people who are drunk tell their secrets.

On the other hand:—

Ether is much less dangerous than chloroform.

Ether produces less vomiting than chloroform.

Ether, instead of depressing the heart, acts as a stimulant to that organ.

Observations made with Roy's apparatus on the ventricle of the frog's heart showed a marked difference between the action of ether and of chloroform. Whilst one or two minims of chloroform rapidly weakened and finally arrested the ventricle, fifty minims of anhydrous ether merely accelerated the beats and weakened them a little, the increased frequency more than compensating for the slightly diminished force of contraction.

Taking it all round, ether is a much better general anæsthetic than chloroform.

Ether, sprayed on the part, is often employed as a local anæsthetic. It is of the greatest value in neuralgia and megrim. It may be used for the removal of small growths, small tumours, etc., but it is not adapted as a local application for big operations. Ether, as a local anæsthetic, has some disadvantages. There is a good deal of pain when the part is being frozen, and there is still more pain when the thaw sets in. In exceptional cases it produces chilblains, and even sloughing of the part.

When ether is used as a general anæsthetic it produces cyanosis, but the smallest admixture of air, by raising the mouthpiece, at once restores the colour. It exerts no depressing effect on the heart, so that the anæsthetist has nothing to do but to look after the respiration.

In addition to its use as an anæsthetic, ether, or the less

pure form, sulphuric ether, is administered internally as an anti-spasmodic in the treatment of hysteria, flatulence, syncope, and asthma.

III. NITROUS OXIDE GAS.

Nitrous oxide gas, or laughing gas, is the best anæsthetic for short operations. It is a tasteless inodorous gas, which supports combustion almost as well as oxygen. For anæsthetic purposes, it is condensed, and is supplied in iron bottles. When given mixed with air it produces exhilaration of spirits, but when administered pure it produces cyanosis and anæsthesia. The anæsthesia is due to the diminution of oxygen contained in the blood. The gas itself undergoes no change, and if passed over lime, to deprive it of the carbonic acid, can be used again.

The effect lasts about thirty-five seconds, and a sharp dentist in this time will extract three or four teeth. If, however, he has a difficult job, he may fail to extract one in this time. It is never desirable to administer nitrous oxide gas more than once at a sitting. It is safer to extract as many teeth as possible under the one administration, and to make the patient come on successive days for the remainder.

Dr. Hewitt advocates the employment of oxygen gas in conjunction with nitrous oxide as an anæsthetic, and judging from the results of 805 cases which he records, the combination seems to be a happy one.

IV. ETHIDENE.

Ethidene, or ethidene dichloride, is one of the bye-products in the manufacture of chloral. Its effects are

intermediate between those of chloroform and ether. Its odour is generally preferred to that of ether, and it has the advantage of not readily catching fire. It may be used both in major and in minor operations, and the effects soon pass off on discontinuing its administration, there being very little subsequent nausea or vomiting. In large doses it exerts a depressing action on the heart, the effect being identical with that of chloral and chloroform. It seems probable, from observations made with Roy's apparatus, that on the ventricle of the frog's heart ethidene dichloride acts not only in the same way as chloroform, but in an equal degree. The depressing action of the anæsthetic in both cases is readily antagonized by the addition of a small dose of ammonia.

Ethidene dichloride was the favourite anæsthetic with the late Mr. Clover, who gave it in nearly two thousand cases. He usually gave nitrous oxide first, and then went on with the ethidene. The patient usually falls asleep without moving a limb, there is a little convulsive twitching followed by stertorous breathing. The pupils dilate with the onset of the stertor, but if a little air is admitted with every third or fourth respiration, they rapidly contract. Under the influence of the drug the dreams are generally pleasant, and the patient often thinks that he is travelling rapidly to the accompaniment of soft music. When he awakes it is as if from a natural sleep, and he can talk clearly and walk without difficulty. In giving ethidene it is necessary to watch the pulse, and to remember that it cannot be given with the same freedom as ether.

Ethidene has lost ground as an anæsthetic, and no longer occupies the place it did in popular favour.

V. "A.C.E." MIXTURE.

The "A.C.E." mixture was originally introduced by Dr. George Harley. It consists of—

Alcohol	1 part.
Chloroform	2 parts.
Ether	3 parts.

Its action is midway between that of chloroform and ether. It is a good anæsthetic and is fairly safe, but not so safe as ether.

There are a good many other mixtures in which chloroform and ether, or alcohol, chloroform, and ether, are combined in various proportions.

The substance known as methylene was originally introduced as a simple substance, but it seems probable that in reality it is a mixture of methylic alcohol (wood spirit) and chloroform.

There are a great number of combinations which can be employed as anæsthetics in surgical operations, and in the hands of an expert good results can be obtained with any of them. It must be remembered that every anæsthetist has some one favourite anæsthetic, and from constant practise he gets to know the behaviour and capabilities of his agent, so that he becomes a specialist or expert in its employment.

IODOFORM.

Iodoform is made by the action of iodine on a mixture of alcohol and solution of carbonate of potassium.

It is met with in two forms, powdered iodoform which is

in small crystals, and precipitated iodoform which is an impalpable powder. The powdered iodoform is usually preferred by surgeons, as it does not "clot;" but the precipitated form is less irritating, and is more commonly employed for dusting on sores.

Iodoform is an antiseptic and deodorizer. It is a powerful local anæsthetic, but produces no local irritation.

In frogs it weakens the action of the heart, exerting a powerful paralyzing action on the cardiac muscle. Experiments with Roy's apparatus on the ventricle of the frog's heart, show that it is a much more powerful cardiac depressant than even chloroform. The iodoform was used in the form of a one per cent. solution in rectified spirit. It was found that one-fifth of a grain arrested the action of the ventricle, whilst it required two minims of chloroform, weighing about a grain and a half, to produce this result. The action of iodoform on the heart is promptly antagonized by ammonia, only to be reproduced by the application of a further dose of ammonia. This may be repeated many times, affording a complete demonstration of the mutual antagonism of the drugs on the frog's ventricle.

In man it sometimes acts as an anæsthetic. The case is recorded of a patient who was ordered a gramme of iodoform as an application to a chancre. He used it on going to bed, and failing to replace the cork in the bottle, the contents were scattered over the sheets. The room was small, and the night was hot. The patient passed into a deep slumber, from which he was aroused some twenty-four hours later with much difficulty. His clothes and breath smelt strongly of iodoform during the whole of the following day.

In another case a patient took seventy-five grains of iodoform in pills in the course of a week. Somnolence supervened, the gait became unsteady, and there was pain over the entire circumference of the head. After this

condition had lasted for a day a comatose condition supervened, which persisted for five days, the patient, however, taking nourishment without difficulty.

In still another case the patient took ten and a half drachms of iodoform in pills in eighty days. At the end of this time vertigo, weakness, and double vision were noted. These symptoms lasted two and a half days, and were followed by sleepiness, alternating with excitement and incoherence of speech, which persisted for twelve days.

Binz is of opinion that this comatose condition is due to the liberation of iodine in the system, the iodine acting on the brain cells in such a way as to inhibit their functions.

In surgical practice cases of iodoform poisoning are not of uncommon occurrence, especially when the drug is employed in large quantities. The most common symptoms are slight nocturnal delirium, drowsiness, progressive emaciation, high temperature, and a rapid pulse. In some instances the temperature has risen to 105·8° F., and the pulse to 150 in the minute. The patient becomes languid, complains of dizziness and mental confusion, and finally relapses into a lethargic condition. There may be paralysis of the sphincters, and death may occur suddenly. The most dangerous symptoms are those associated with disturbances of the cerebral functions.

When in surgical cases iodoform is used in large quantities as a packing for cavities, or in injuries to the joints or open wounds, it may act as a foreign body, becoming in process of time incorporated with newly-formed connective tissue, in which it may remain encapsuled after the completion of the healing process. In such cases it usually makes its presence felt by giving rise to an iodoform abscess, the existence of which is indicated by a circumscribed swelling. The contents consist of pure iodoform mixed with a little mucus.

Iodoform, when applied freely to a wound or deep sinus, cannot be removed simply by washing with water, and oil of eucalyptus has to be employed as a solvent.

Symptoms of iodoform poisoning are most likely to occur when the drug is employed in conjunction with carbolic acid, the carbolic acid acting on the kidneys, and rendering them temporarily incapable of eliminating the iodoform.

There is no advantage in employing iodoform in such large quantities, and its antiseptic effects are amply secured by smaller and non-toxic doses, and in the case of wounds by simply dusting it on the surface from a dredger.

When iodoform is used in the form of a suppository it produces anæsthesia, so that the patient defæcates without his knowledge.

Iodoform is split up in the blood, and iodine appears in the urine in the form of iodide of sodium.

The characteristic odour of iodoform is to some extent masked by the addition of Tonquin bean. Half a drachm of oil of sanitas, mixed with an ounce of ointment containing a drachm of iodoform, will effectually mask its odour without impairing its efficacy. Iodoform is soluble in a saturated solution of camphor in spirit, and this also covers the smell.

Iodoform is a local application, is a specific for the soft chancre, and since its introduction, this form of sore has practically ceased to be an active factor in the life of the surgeon. Iodoform is useful in all forms of suppurating ulcer due to venereal poisoning. Whether the sore be indurated or not, if there is ulceration and discharge, iodoform will invariably put an end to it. If there is induration the sore remains hard in spite of it, but it becomes clean and it heals. In many forms of tertiary syphilis this drug is of the greatest value. In the

tertiary syphilitic ulcers of inherited syphilis it is surprisingly efficient. In all forms of phagadænic action it should be resorted to without delay.

In the treatment of gonorrhœa, bougies four inches long, composed of iodoform and oil of eucalyptus, are employed.

Dr. Foxwell, of Birmingham, who has had considerable experience of the internal administration of iodoform, regards it as almost a specific for phthisis. He gives it in grain pills, six times a day. He finds that it gives better results than any other drug or combination of drugs with which he is acquainted. It soothes the nervous system of erethic subjects, it lessens cough and expectoration, it powerfully stimulates nutrition, and markedly improves the condition of the physical signs. One of his patients took fifty grains a day without inconvenience, and another took from twenty to thirty grains a day for two years and a half with no detectable ill-effect. It would appear from these observations that iodoform exerts as marked an influence on phthisis as mercury does in syphilis. Dr. Foxwell did not meet with the comatose condition described by other writers as the result of the employment of large doses of iodoform. It would seem probable that in these cases the drug acts as a pure antiseptic, and not by virtue of the iodide of sodium, into which it must be converted in the blood. I have employed the iodoform treatment in a large number of cases, both of phthisis and winter cough, and although in the main I confirm Foxwell's treatment, I have met with several cases in which the employment of large doses had to be abandoned on account of the nausea and vomiting resulting from the administration of the drug, and the powerful odour which it imparted to the breath of the patient.

Iodoform is conveniently made into pills with sugar of milk and glycerine of tragacanth.

For insufflation in cases of laryngeal phthisis, the following is an excellent powder:—

Powdered iodoform	2 drs.
Powdered boracic acid	2 drs.
Menthol	10 grs.
Powdered phosphate of lime ...	to 1 oz.

A useful antiseptic powder, sometimes known as Cavazzini's, is made as follows:—

Iodoform	55 parts
Salicylic acid	20 parts
Subnitrate of bismuth	20 parts
Camphor	5 parts

It has an agreeable odour, and is not irritating. It is employed as an external application.

An iodoform ointment, useful in the treatment of indolent or foul-smelling wounds or ulcers, is made as follows:—

Iodoform	1 dr.
Oil of eucalyptus	1 oz.
Soft paraffin	$2\frac{1}{2}$ ozs.
Hard paraffin	$2\frac{1}{2}$ ozs.

CHLORAL.

The substance used in medicine is Chloral Hydrate. It was introduced into medicine in 1869, by Oscar Liebreich, the Professor of Pharmacology in the University of Berlin. He found that it was decomposed by alkaline solutions into formic acid, which combined with the alkali, and chloroform. He thought that it would be split up in the same way by the alkalinity of the blood, and would be useful as an anæsthetic. There is reason to suppose that this theory is incorrect. In animals poisoned with chloral, chloroform

cannot be detected in the blood, excreta, or breath; whilst in animals poisoned with chloroform itself, the detection is by no means difficult. It has also been shown that in the "salt-frog," a frog, that is, in which the blood is replaced by a saline solution, chloral produces its characteristic effects. The expired air of chloralized animals contains no chloroform, and all the evidence points to the fact that chloral is not split up into chloroform in the blood.

When chloral is given to a patient it induces sleep, a quiet sleep closely allied to natural sleep. The sleep is generally calm, refreshing, and dreamless, and is not too profound to prevent coughing, or even to interfere with taking food. A patient aroused from a chloral sleep will take nourishment, and then lie down and sleep again. Sleep after an ordinary medicinal dose, may come on in a few minutes, or may be postponed for half an hour. The dose should always be given when the patient is actually on the point of retiring to rest, and he should remain quiet and avoid excitement, or it may produce restlessness instead of sleep.

The after effects of chloral are usually slight; sometimes it produces on the following morning a good deal of heaviness and sleepiness, and occasionally frightful dreams, excitement, intoxication, and delirium. As a general rule, however, it causes no giddiness, headache, nervous depression, constipation, sickness, or loss of appetite.

The pulse, when only a moderate dose is taken, remains unaffected, or is rendered only slightly slower. The pupils are contracted, but become normal as soon as the patient awakes.

When larger doses are taken, sleep is more profound and may pass into coma. The respirations fall in number, the pulse is weakened and rendered slower, but may become rapid and irregular if the dose amounts to a toxic one. The

muscular system is relaxed, and both sensibility and reflex action are diminished.

If a fatal dose has been taken all these symptoms are intensified. There is coma with intense muscular relaxation, the pulse is weak and thready, the pupils are at first contracted and then dilated, the respiration is shallow, and there is well marked paralysis.

The slowing of the pulse is not due to the action of the drug on the vagus, for it occurs after section of that nerve and after it has been paralyzed by atropine. The stoppage of the heart is due to paralysis of the cardiac ganglia, as the heart contracts readily when its muscular substance is stimulated directly.

The sleep induced by chloral is due partly to the direct action of the drug on the brain, and partly to contraction of the blood-vessels supplying that organ. Chloral first congests the retina, but subsequently contracts the vessels so that the retina assumes a pale pink colour.

The paralysis caused by chloral is due to the direct action of the drug on the spinal cord. Chloral acts first on the grey matter of the cord, and impressions, which are usually painful, are unperceived at a stage when tactile impressions still produce reflex movements.

After large doses of chloral the blood pressure is much lessened, and this is due in part to vaso-motor paralysis, but still more to the depressing action of the drug on the heart.

In cases of poisoning the heart is arrested in diastole. The arrest is not muscular in origin, but is due to the influence of the drug on the centres at the base of the brain.

One of the most characteristic actions of the drug is the fall in temperature, induced in cases in which large doses have been administered. It may fall as much as seven degrees, and it is not uncommon for it to fall until it can no

longer be measured by the clinical thermometer. An animal which would die from a certain dose of chloral can be kept alive if wrapped in cotton wool so as to maintain the temperature.

Summing up the action of chloral, it may be said that it acts upon the cerebrum as a powerful and certain hypnotic; that it acts as a depressant to the centres at the base of the brain; that it depresses the functions of the spinal cord; and that it produces slowness and weakness of the heart's action, vaso-motor paralysis, and muscular weakness with anæsthesia. In fatal doses it causes death by arresting, through paralysis of the nerve centres, first respiration and then the heart, which stops in diastole. It exerts no influence on the vagus, and none on the motor nerves.

In exceptional cases chloral, even in medicinal doses, produces irritation of the conjunctivæ. The "chloral rash," like many medicinal rashes, assumes various forms. It may be an erythema, scarlatinaform in appearance, and followed by desquamation, or it may be an urticarial rash, or it may be an eczema. It is rarely persistent, and disappears without treatment. It may be accompanied by fever, but it would be unwise to give quinine to reduce the temperature, as the case might be complicated by the appearance of a quinine rash.

Chloral is excreted by the urine, unaltered so long as the urine is acid; but when the urine is alkaline, the chloral is partly decomposed into chloroform.

The custom of taking chloral as a nerve sedative seems to be steadily on the increase. Many ladies never think of travelling without it, and resort to a dose of the syrup on the slightest provocation. Many of these people are large cigarette smokers, and indulge freely in alcohol, so that it is difficult to say how much is due to chloral, and how much to other disturbing influences.

The symptoms of "Chloralism" are :—

1. Digestive troubles, probably due to the direct action of the drug on the mucous membrane of the stomach.

2. Dyspnœa, which may be slight, and experienced only on exertion, or may be persistent and alarming.

3. Skin eruptions, usually urticarial in character, although they may assume the form of petechiæ or ecchymoses. Ulceration about the nails is not uncommon.

4. The patient exhibits an excited, hurried manner, is voluble in speech, and suffers from vertigo, wakefulness, and depression of spirits.

5. Enfeebled nerve power and weakened mental activity.

It is probable that the habitual chloral-eater is not fully responsible for his actions. It is said that a sudden withdrawal of the drug will induce a condition allied to delirium tremens, and it has certainly been known to induce a mental condition in which the patient is temporarily irresponsible for his acts.

Chloral should not be administered with alkalies.

Chloral is most closely allied in action to paraldehyde, and is antagonized by strychnine, and members of that group, and to some extent picrotoxin.

BUTYL-CHLORAL-HYDRAS.

This substance, which was introduced into medicine by Oscar Liebreich, was originally known as croton-chloral.

Its chief characteristic is that it produces anæsthesia of the fifth nerve, and of the parts supplied by it.

In large doses it has much the same action as chloral-hydrate, although it has a less depressing action on the heart.

It is largely employed in the treatment of facial neuralgia, and in cases of megrim and hemicrania.

It is often given in neuralgia, in combination with gelsemine, the active principle of gelsemium sempervirens, the following being a useful mode of administration :—

Butyl-chloral-hydrate	3 grs.
Hydrochlorate of gelsemine	$\frac{1}{200}$ gr.
Glycerine of tragacanth	$\frac{1}{2}$ gr.

To make a pill.

One every four hours.

PARALDEHYDUM.

Paraldehydum, or paraldehyde, is a clear, colourless fluid, which was introduced as a substitute for chloral. It has a characteristic ethereal taste, and is usually given in doses of from half a drachm to a drachm and a half, flavoured with simple elixir.

It is rapidly absorbed, and produces its effects quickly.

It is eliminated by the lungs, and its odour may be detected in the breath twenty-four hours after the last dose was taken.

It may give rise to dyspepsia, nausea, and free perspiration.

The reports of its action received by the Therapeutic Committee of the British Medical Association were on the whole favourable, but no one seemed to be particularly enthusiastic about it.

In cases of poisoning, the treatment would be the same as for chloral.

The following formula is offered tentatively as a convenient mode of giving this drug :—

Paraldehyde	$\frac{1}{2}$ oz.
Tincture of vanilla	20 mins.
Alcohol	$\frac{1}{2}$ oz.
Syrup	1 oz.
Water	to 4 ozs.

A table-spoonful at bedtime.

It is sometimes given in the form of an emulsion:—

Paraldehyde	$\frac{1}{2}$ oz.
Oil of gaultheria	15 mins.
Powdered gum acacia	2 drs.
Syrup of Virginian prune	1 oz.
Water	to 4 ozs.

A tea-spoonful in water every four hours.

SULPHONAL.

Sulphonal was discovered by Professor E. Baumann, of Freiburg, and its physiological properties were investigated by A. Kast, who, in 1888, gave an account of its action.

The chemical name of this substance is diethyl-sulphon-dimethyl-methane, and it is an oxidation product of the union of ethyl-mercaptan with acetone.

It is met with in the form of colourless, inodorous, and nearly tasteless crystals.

It is given in doses of from fifteen to forty grains, either in hot beef-tea, or in brandy and water. It is absorbed slowly, and should be given a couple of hours before the hypnotic influence is required.

It is not altogether a harmless substance. It may produce giddiness, ataxic movements, and loss of motor power in the legs. Patients after having a dose not uncommonly complain of being unable to stand, and say that they cannot walk properly. They present the appearance of being drunk, and tumble about in an unsteady and unpleasant manner. Sometimes they develop a skin eruption. When sulphonal is administered continuously for some weeks at a time they suffer from gastro-intestinal disturbance, vomiting, and constipation, with, from time to time, swelling of the

joints, pain in the lower extremities, failure of co-ordination, a scanty secretion of urine, and other symptoms.

Sulphonal is most closely allied in physiological action to trinal and tetranal. Sulphonal contains only two ethyl groups in its molecule, trinal (diethyl-sulphon-methyl-ethylmethane) contains three, whilst tetranal (diethyl-sulphon-diethylmethane) contains four.

NITRITE OF AMYL.

Nitrite of amyl is made by the action of nitric or nitrous acid on pure amylic alcohol. It is a yellow ethereal fluid, having the odour of Jargonelle pears. It rapidly deteriorates by keeping, and becomes "stale." It is often put up in the form of glass capsules, but these have no particular advantage over specimens of the drug kept in well-stoppered bottles.

When inhaled it flushes the face, and induces perspiration. It accelerates the pulse, and causes the heart to beat strongly, inducing a sensation as if the head were full to bursting. The dilatation of the arteries is due to paralysis either of the muscular walls of the arterioles themselves, or of the vaso-motor ganglia. The paralyzing effect on the arterial system is sufficiently indicated by the sphygmographic tracing, by the flushing of the face, and by the increase in size of the visible arteries such as the temporal.

The influence of nitrite of amyl on the pulse is well shown in the series of sphygmographic tracings on the opposite page.

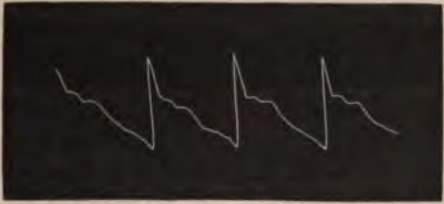
The loss of reflex action observed in the lower animals is due to depression of the motor tracts of the cord.

The action of nitrite of amyl on the blood has been fully investigated by Dr. Arthur Gamgee.

Nitrite of amyl gives rise to the formation of methæmoglobin in the blood, the blood itself assuming a chocolate-brown colour and yielding brown hæmoglobin crystals, which probably consist of methæmoglobin. The blood both

No. 1.—Before inhalation.

No. 2.—One minute after inhalation.



No. 3.—Two minutes after inhalation.

in the arteries and the veins assumes this brown colour, and oxidation in the body is interfered with to a marked degree, so that in rabbits convulsions closely resembling those of asphyxia are induced.

The action of nitrite of amyl on the blood is shared by other nitrites, such as the nitrites of potassium, sodium, and silver, and these effects may be briefly summarized as follows:—

1. The nitrites produce a peculiar change in the colour of the blood and in the absorption-spectrum.

2. These changes are due to the formation of compounds possessing the same crystalline form, colour, and spectrum, whatever nitrite is employed.

3. These bodies are compounds of the nitrite with oxidized hæmoglobin.

[illegible] compounds with hæmoglobin they differ [illegible] oxygen. The addition [illegible] locking up of the [illegible] irremovable by [illegible]

[illegible] arrest of oxidation. [illegible] sugar appears in the urine. [illegible]

Many patients suffer so severely from even a small dose of the drug that they are unwilling to repeat the experiment.

The chief use of nitrite of amyl is for relieving the paroxysms of angina pectoris. It should be inhaled, and the best plan is to pour a few drops on the palms of the hands or on a pocket-handkerchief. Chemists are very fond of selling nitrite of amyl in glass capsules which are intended to be broken, but there is no possible advantage in this arrangement, for nitrite of amyl is not a substance the use of which requires to be regulated with any particular care. The most convenient plan is for the sufferer from angina pectoris to carry one or two drachm bottles of the drug in his waistcoat pocket. It is always ready for use, and it avoids the trouble of breaking a glass capsule. The great point to remember about nitrite of amyl is that it gets stale by keeping, so that the bottles must be replenished every third or fourth day. Nitrite of amyl would act probably well if given internally in brandy, but it is not absorbed so quickly as by the lungs, and in a severe attack the patient is anxious to obtain relief as speedily as possible.

In addition to its use in angina pectoris nitrite of amyl has been given with some success in the treatment of asthma, in megrim, and in Bright's disease.

Nitrite of amyl has no lethal action. Some years ago a bottle of nitrite of amyl was upset over the bed of a paralyzed woman. The nurses fled from the room, and on returning some time later were surprised to find the patient quite unaffected and anxiously inquiring what was the matter. Squibb, the American chemist, by accident broke a flask containing about two pints of nitrite of amyl, which ran over the table and floor of the room. It was necessary to turn out several burners which were alight, so that he was exposed for some minutes to a very concentrated vapour. The effect of the drug was decidedly stimulating,

but he experienced no ill-effects, and did not lose consciousness. A hospital patient of mine, who was suffering from angina pectoris, was ordered a bottle of nitrite of amyl to inhale during his paroxysms, and some cough linctus. Being disturbed during the night he reached out of bed for his cough medicine, and took a mouthful of the amyl by mistake. In a few minutes it was rejected by vomiting, when, finding the room was rather oppressive, he put on his clothes and went down to the front door, where he found the other members of the household assembled in scanty attire, the smell of the drug having disturbed them from their slumbers.

NITRO-GLYCERINE.

Nitro-glycerine was discovered in 1847 by Sobrero. It is commonly prepared by what is known as Liebe's process. Half an ounce of dehydrated glycerine is poured with constant stirring into a mixture of two ounces of oil of vitriol and one ounce of fuming nitric acid of specific gravity 1·52, the temperature of the mixture being kept below 25° C. (77° F.) by external cooling with ice, and as soon as oil drops begin to form on the surface, the mixture is poured with constant stirring into fifty ounces of cold water. Nitro-glycerine then separates, and may be purified by washing and drying in small quantities in a vapour bath. The greatest care must be taken in the process, the glycerine being added drop by drop, and the temperature carefully noted by means of the thermometer. The nitro-glycerine thus obtained must be well washed to free it from traces of acidity. It appears first as a white opaque milky-looking oily fluid, but on careful drying by exposing it in a warm room in flat dishes containing thin layers, it becomes dehydrated and forms a transparent colourless oily

fluid. It is slightly soluble in water, and dissolves freely in absolute alcohol, rectified spirit, and ether, and also in fats and oils. It is, although slightly volatile, inodorous, and has a sweet pungent aromatic taste. It crystallizes or freezes at low temperatures. It is largely employed as an explosive in mining and blasting operations, being fired by percussion, and forms the basis of the compounds known as "dynamite," "glyoxylon," "dualin," etc. When boiled with potash it decomposes, glycerine and nitrate of potash being formed. Matthew Hay maintains that nitro-glycerine is really a nitrate of glyceryl, and not a nitrite.

Although nitro-glycerine is official in the sense of there being two official preparations of the drug, no directions are given in the Pharmacopœia for its manufacture, and the omission is dictated by considerations of public safety, it being considered unwise in a work issued by authority to lay down rules for making so dangerous an explosive.

In case the susceptibilities of any nervous patient might be wounded by the name nitro-glycerine, the term trinitrine has been admitted as a synonym.

The two official preparations of nitro-glycerine are the one per cent. alcohol solution known as liquor nitro-glycerini or liquor trinitrinæ, and the tablets or tabellæ, made with chocolate and containing one-hundredth of a grain of nitro-glycerine in each. The solution is in every way an excellent preparation, but it is doubtful if the tabellæ serve any very useful purpose.

The action of nitro-glycerine on the lower animals has been investigated both in this country and on the continent. A dose of six minims of a ten per cent. solution, injected under the skin of a frog, produced, among other symptoms, languor, tetanus, and finally paralysis. Immediately after the injection the animal became restless, and the respirations very rapid. In a minute or two this restlessness subsided

and gave place to lethargy, the frog showing a disinclination to move. The respiration continued rapid, and in about five minutes from the commencement of the observation the animal gave a sudden spring and fell into tetanic convulsions. These lasted about half a minute, and then passed off; they soon returned, however, and were readily excited by touching the animal. After continuing for some time they gradually became weaker, and the animal died. In some instances, the mouth seemed to be the part first affected by the convulsions, as the jaws were seen to open and shut; but possibly this action was connected with respiration, rather than with the general convulsions. Next it spread to the fore limbs, and finally to the hind ones. It was noticed, too, that the fore limbs were more sensitive than the hind, as slight spasmodic twitches could sometimes be produced by touching or pinching the former, when similar irritation of the latter had no effect. To ascertain whether the tetanus was due to the action of the drug on the spinal cord, or on the nervous centres within the encephalon, the spinal cord was cut across before the poison was given. The upper part of the animal immediately became very restless, the fore limbs were outstretched with the toes spread out; but there was no alteration in the hinder part of the body or in the hind limbs. This result was confirmed by another experiment. A frog was decapitated, and after the spinal cord had recovered from the shock, and reflex movements were again observed, the drug was injected, but no spasm occurred. It is probable that the tetanus is not due to any action on the cerebral lobes, but to the effect of the poison on the optic lobes.

The principal effects produced on cats by nitro-glycerine are great acceleration of respiration, paralysis, loss of reflex action and sensibility, and death from arrest of respiration. It is recorded that a dose of about sixty minims of a ten

per cent. solution having been injected into the peritoneal cavity of a cat, there was observed in a few minutes a stretching movement of the hind leg, as if the animal were trying to shake something off the foot. Half an hour later the animal vomited, and at the expiration of about an hour, during which the legs seemed to fail in walking, it sank down never to rise again. Vomiting occurred again once or twice, breathing became very rapid, and the tongue was drawn backwards and forwards as in a dog that has been running. Slight spasm-like hiccup then set in, and five minutes later the animal was dead—a little over two hours after the injection of the poison. The loss of reflex action noticed in the observations on the frog and cat, in the advanced stages of poisoning, indicate that the cord is paralyzed; and from the persistence of reflex action, in parts supplied by the cranial nerves, after its disappearance from other parts of the body, it would seem that the spinal cord is paralyzed, before the ganglia at the base of the brain.

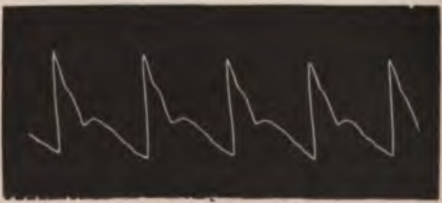
Nitro-glycerine dilates the blood-vessels in much the same way as nitrite of amyl, but its action is much more persistent. Nitro-glycerine does not flush the face, or only to a very slight degree, but it produces a most persistent headache. Some people are much more susceptible to the action of the drug than others, the merest contact with a specimen being sufficient to induce in them a headache of many hours' duration.

The effects of nitrite of amyl and of nitro-glycerine on the pulse are similar. Both drugs produce a marked state of dicrotism, and both accelerate the rapidity of the heart's action; they differ, however, in the time they respectively take to produce these effects. The full action of the nitro-glycerine is not observed in the sphygmographic tracings until six or seven minutes after the dose has been taken. In the case of nitrite of amyl the effect is obtained in from

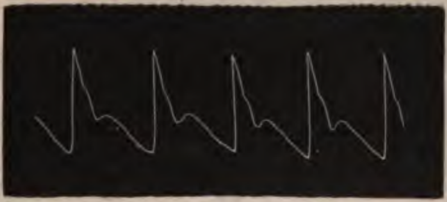
fifteen to twenty seconds, after an inhalation, or a dose has been taken on sugar. The influence of the nitrite of amyl is extremely transitory, a tracing taken a minute and a half after the exhibition of the drug being perfectly normal. In fact, the full effect of the nitrite of amyl on the pulse is not maintained for more than fifteen seconds. The nitro-glycerine produces its effects much more slowly; they last longer, and disappear gradually, the tracing not resuming its normal condition for nearly half an hour. The effect may be maintained for a much longer time by repeating the dose. Nitro-glycerine is more lasting in its power of producing a dicrotic form of pulse-beat, and, consequently, in cases where the conditions of relaxation and dicrotism are desired to be maintained for some space of time, its exhibition is to be preferred to that of nitrite of amyl.

The accompanying sphygmographic tracings show the effect of a moderate dose of nitro-glycerine on the pulse:—

No. 1.—Before dose.

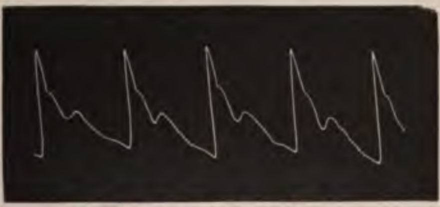


No. 2.—Two minutes after dose.



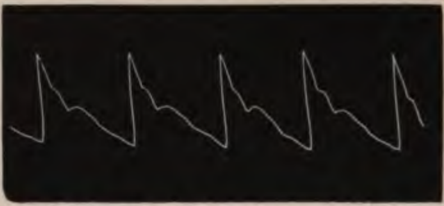
No. 3.—Eight minutes after dose.

No. 4.—Nine minutes after dose.



No. 5.—Ten minutes after dose.

No. 6.—Twenty-two minutes after dose.



No. 7.—Twenty-six minutes after dose.

Nitro-glycerine increases the secretion of urine. I made some observations on this point on an epispadic. The quantities of urine passed were:—

1st quarter of an hour,	$2\frac{3}{4}$	drachms.
2nd ,, ,,	$2\frac{3}{4}$	,,

He was then given fifteen minims of the one per cent. solution in a drachm of water.

3rd quarter of an hour,	12	drachms.
4th ,, ,,	16	,,
5th ,, ,,	$6\frac{3}{4}$	,,
6th ,, ,,	$8\frac{3}{4}$	,,
7th ,, ,,	$5\frac{3}{4}$	,,
8th ,, ,,	3	,,

In another observation on the same patient the following figures were obtained:—

		Sp. gr.	Pulse.
1st quarter of an hour,	4 dr.	—	64
2nd ,, ,,	$10\frac{1}{2}$ dr.	1003	64

Given twenty minims of one per cent. nitro-glycerine in one drachm of water.

		Sp. gr.	Pulse.
3rd quarter of an hour,	7 oz.	1000	80
4th ,, ,,	$7\frac{1}{2}$ oz.	1000	76
5th ,, ,,	1 oz.	1002	72
6th ,, ,,	7 dr.	—	68
7th ,, ,,	$4\frac{1}{2}$ dr.	—	64

The acidity of the urine varied inversely as the quantity passed. Thus, before the administration of the drug, it was distinctly acid, during the third and fourth quarters it was almost neutral, the acidity then gradually returned, till, in the seventh quarter, it was as marked as it had been at first.

Nitro-glycerine is largely used in the treatment of angina pectoris. It relieves the paroxysms of pain promptly. It is almost impossible to lay down definite rules with respect to the dose. It is best to begin with a one two-hundredth of a grain, but the dose can be gradually increased, and many patients take a grain without inconvenience.

A good formula for the administration of nitro-glycerine in cases of angina pectoris is the following:—

Nitro-glycerine	$\frac{1}{100}$ gr.
Nitrite of amyl	$\frac{1}{4}$ gr.
Menthol	$\frac{1}{50}$ gr.
Capsicum	$\frac{1}{100}$ gr.

This may be made into a tabloid or pill and coated. The object is to get rapid absorption, so that immediate relief may be given, and this is facilitated by the introduction of the menthol and capsicum.

Dr. P. M. Mikhalkine, of Nijni-Novgorod, maintains that nitro-glycerine is one of the best remedies for sciatica, and says that it often succeeds in effecting a cure after the failure of antipyrin, phenacetin, acetanalid, and other drugs.

His formula is—

Solution of trinitrine	5 grms.
Tincture of capsicum	$7\frac{1}{2}$ grms.
Peppermint water	15 grms.

The dose is from five to ten drops, three times a day.

SPIRITUS ÆTHRIS NITROSI.

The substance is popularly known as "Sweet Spirit of Nitre." It has been used as a medicine since the beginning of the thirteenth century, but our knowledge of its physiological action is due to the careful observation of Professor Leech, of Manchester. It is defined as "a spirituous substance containing nitrous compounds, aldehyd, and other substances."

Spirit of nitrous ether is a distinct depressor of arterial tension, and it exhibits properties similar to those which have been observed in the case of nitrite of amyl, nitroglycerine, and the nitrites of the alkaline metals. It produces a sense of fulness in the head, a rapid action of the heart, and a suffusion of the skin. The action on the blood is similar to that of nitrite of amyl.

After a full dose of sweet spirits of nitre, the sphygmographic pulse trace invariably indicates a marked fall in arterial tension, and this decreased tension lasts for two or three hours.

The action of the drug on the urine is similar to that of nitro-glycerine, and it induces an increase in the amount of urine passed.

Sweet spirits of nitre is employed as a popular remedy at the commencement of a cold, and as a mild diaphoretic and febrifuge. Its action is, to a very great extent, due to its power of dilating the cutaneous vessels, and exposing a larger amount of blood to the air. It has also been given with success in angina pectoris. It is commonly employed in asthma, and also in painful menstrual disorders.

It may be given in full doses, and the administration of from two to three drachms is not, as a rule, followed by any subjective symptoms.

The physiological action of the nitrites on the blood-vessels is antagonized by the members of the digitalis group, and by the salts of barium.

ACETANELIDUM.

Acetanelidum, or Acetanalid, when first introduced into medicine was known as antifebrin, a term employed to indicate its antipyretic action. It is a crystalline substance, only slightly soluble in water.

It is a powerful depressant of the nervous system. It markedly diminishes the spinal reflexes, and in large doses produces tremors, followed by convulsive movements, a marked fall in temperature, coma, retention of the urine, and general paralysis. Not infrequently the patient suffers from cyanosis, great dyspnœa, and possibly symptoms of collapse. After toxic doses the pulse is weakened and thready, and the respirations become first rapid and then impaired and laboured. The urine is reddish-yellow in colour, from its richness in urobilin, and reduces Fehling's solution. The toxic symptoms are probably due to the formation of aniline.

Acetanalid is an analgesic, and has been used with some success in the treatment of facial and intercostal neuralgias.

It has not maintained its early reputation, and the occurrence of such symptoms as lividity, cyanosis, profuse sweating, with disturbances of the circulatory, respiratory, and nervous system has induced some hesitation in prescribing it. The ordinary dose is from three to ten grains, and it may be given in wine, spirits, tincture of orange, or aromatic spirits of ammonia.

PHENACETIN.

Phenacetin, or para-acetphenetidin, was introduced into practice by Professor Kast and Dr. Hinsberg, in 1887.

It is a substance closely allied to antifebrin. It is met with in the form of colourless, odourless, and tasteless crystals, which are only sparingly soluble in cold water. It has been used with success in cases of headache and neuralgia.

It is specially useful in the fugacious and variable neuralgias, which are so commonly met with in the hysterical and neurotaxic.

It may be given in five-grain doses, and is usually administered either in cachets, or dissolved in simple elixir. There is no doubt that it is a good antipyretic; but its use requires caution. Even in the case of robust individuals a dose of from fifteen to thirty grains will produce a feeling of fatigue, with yawning and somnolence, a condition often followed by vertigo, shivering, weakness of the pulse, and hurried respiration.

Its extreme insolubility renders it somewhat unmanageable, and confers on it a marked inferiority to many other members of the aromatic series.

PHENAZONUM.

This is our old friend, Antipyrin, under another name. It is also known as analgesin, but its full and proper name is Phenyl-dimethyl-parazolone. It was discovered by Dr. Knorr, and its physiological action was first investigated by Dr. W. Filehne. It is made by a complex process which it is impossible to describe within the limits of an ordinary-sized text-book.

It occurs in the form of colourless, odourless scales, which have a somewhat bitter taste, and are freely soluble in water, and in rectified spirit. This solubility in water gives it a decided advantage over other similar preparations. It has a basic action, and combines readily with acids to form salts, but it is probably not a true alkaloid.

It was originally introduced as an antipyretic, but, after a time, was employed almost exclusively as an analgesic. It has been recommended for all sorts of complaints, and in the last influenza epidemic was freely recommended as a specific in all the daily papers without a single word of warning as to its toxic action. At the present time it is probably much more largely employed by the public than prescribed by medical men. It has unfortunately passed into the category of popular remedies.

After small doses, the symptoms not infrequently observed are epigastric pain, nausea, and vomiting, followed by weakness of the pulse, hurried respiration, and cyanosis. In some cases there is persistent sneezing, with lachrymation, and a flow of mucus from the nostrils.

After larger doses the symptoms observed are intense headache, persistent vertigo, loss of memory, confusion of ideas, and deafness.

In several cases collapse has followed the administration of twenty-grain doses, the condition of the patient being for some time critical.

Even when serious symptoms are not observed, the patient frequently suffers from persistent itching of the inner sides of the thighs with a painful urticarial rash, which gradually extends upwards over the abdomen.

It is probable that phenazonum exerts a decided influence on metabolism. The temperature, pulse-frequency, and blood-pressure are all reduced, and the amount of urea excreted is lessened. After large doses, methæmoglobin is

formed in the blood, a circumstance which accounts for the frequency with which cyanosis is observed. The fall of temperature which follows the administration of the drug in cases of fever is not due to the production of sweating, as it has been observed when atropine has been previously administered to prevent the action on the skin. There is clearly diminished heat production, which is, in all probability, due to the fact that antipyrin is a general protoplasmic poison. The drug is eliminated by the urine.

Phenazonum has been employed in a vast number of diseases, and for the relief of all kinds of symptoms.

It is prescribed in all forms of megrim and neuralgia, in dysmenorrhœa, and menorrhagia, in gout, asthma, and a variety of other complaints.

COLLODIUM.

Pyroxylin, or gun-cotton, is made by the action of a mixture of nitric acid, and sulphuric acid on cotton wool.

Collodium is made by dissolving gun-cotton in a mixture of ether and rectified spirit. Flexible collodion, is collodion mixed with Canada balsam and castor oil.

Collodion is employed as a local application to small wounds and cuts, brings the edges together, and arrests bleeding. The part should be carefully dried before the collodion is applied. It is used to prevent the bleeding from leech bites, in small burns, and for cracked nipples.

The flexible collodion does not crack, and is more useful in protecting the subjacent tissues, but it exerts less pressure than the ordinary collodion.

ANTISEPTICS.

Antiseptics are substances which prevent or retard putrefaction. They do this by destroying or preventing the

development of the bacilli which give rise to septic decomposition. They are employed chiefly in surgical operations, and in the treatment of open wounds. The best are those which, acting efficiently on the ferment, exert no injurious effect on the tissues themselves.

Amongst the chief anæsthetics are :—

Carbolic acid and the sulpho-carbolates.
Creasote.
Salicylic acid, salicylate of sodium, and salicin.

Resorcin.
Menthol.
Thymol.
Eucalyptol.

Borax and boracic acid.

Perchloride of mercury is probably the most powerful of all antiseptics, but it is very poisonous.

Most of the essential oils, *e.g.* oil of cloves, oil of thyme, oil of cajeput, and oil of pepperment, possess antiseptic properties.

I. CARBOLIC ACID.

Carbolic acid, phenic acid or phenol, is an acid obtained from coal-tar oil by distillation. When pure it is in the form of colourless acicular crystals, which melt at 95° F., forming an oily liquid. It has strong peculiar and characteristic odour and taste. The crystals readily absorb moisture from the atmosphere. It is not very soluble in water, but dissolves readily in alcohol, ether, and glycerine. Although an acid, it does not redden litmus paper. It coagulates albumin.

It is fatal to all forms of animal life, from the highest to the lowest, and its use both in surgery and medicine is for the most due to its action on infusoria and fungi.

In most animals when given internally it causes intense muscular weakness, followed by convulsions and stupor. It is probable that the convulsions are due to a tetanizing influence on the spinal cord; at all events, it produces very little effect on the nerves or muscles. It acts as a cardiac depressant, and its influence on the respiratory and vascular nervous centres is indicated by frequent and dyspnœic breathing, and by a transitory rise of blood pressure. In man, headache, giddiness, weariness, and discomfort precede the stupor. Death results both in animals and in man from collapse, due to paralysis of the respiratory and vascular nerve centres.

When applied to the skin, carbolic acid acts as an anæsthetic. At first it causes slight burning, and then the skin becomes numb, white, and shrivelled, so that an incision may be made without causing pain. After a prolonged application, or if the acid is applied in a concentrated form, the skin sloughs, giving rise to an eschar, which is dry and falls off without suppuration.

When swallowed in a concentrated form it acts as a caustic to the mucous membrane, causing intense pain, nausea, vomiting, and symptoms of gastro-enteritis.

It is excreted by the kidneys and turns the urine black, the discoloration being due to some oxidation product of carbolic acid, probably hydroquinine. It appears in the urine in combination with sulphuric acid in the form of sulpho-carbolates. The earliest symptoms of carbolic acid poisoning is the disappearance of the sulphates from the urine.

In cases of poisoning the best treatment is the administration of Epsom's salts and Glauber's salts in plenty of

water. White of egg and olive oil are useful in protecting the irritated mucous membranes with which the acid has come in contact.

Sulpho-carbolic acid is formed by the direct union of pure carbolic acid with sulphuric acid.

Sulpho-carbolate of sodium is made by neutralizing the acid with carbonate of sodium, evaporating down and crystallizing.

Many sulpho-carbolates have been obtained. They are simply a convenient form of giving carbolic acid. They have decided antiseptic properties, but in this respect are inferior to carbolic acid itself.

Sulpho-carbolate of sodium is decomposed in the blood, sulphate of sodium being eliminated with the urine, and carbolic acid with the breath.

The use of sulpho-carbolates has been suggested in phthisis, but the suggestion is of no practical value.

Sulpho-carbolate of sodium is used in the treatment of flatulence, and the following formula is often employed:—

Sulpho-carbolate of sodium	20 grs.
Camphor water	1 oz.

To be taken every four hours.

Creasote is obtained by the destructive distillation of wood, and in general properties is closely allied to carbolic acid. It is prescribed in three-minim doses in the form of a pill, and is useful in chronic bronchitis and gangrene of the lung. The following mixture has been found useful in phthisis:—

Creasote	1 min.
Tincture of opium	2 mins.
Spirit of chloroform	15 mins.
Glycerine	1 dr.
Water	to 1 oz.

To allay the irritative cough of phthisis resource may be had to the following linctus:—

Creasote	$\frac{1}{8}$ min.
Glycerine	7 mins.
Water	to 1 dr.

II. SALICYLIC ACID.

There are two kinds of salicylic acid—the natural and the artificial.

Salicylic acid was originally prepared from salicin, oil of winter green, and other sources, and this is the variety known as natural salicylic acid.

Later on it was prepared by heating carbolic acid with caustic soda, and passing a stream of carbonic acid through it. In 1874 Kolbe introduced an improved method of making it on a large scale at a moderate cost. A concentrated solution of caustic soda is evaporated with phenol to a dry powder; this is then heated to 212° F., whilst a stream of dry carbonic acid is passed over it. The acid prepared from carbolic acid is known as artificial salicylic acid.

The natural and artificial varieties of salicylic acid differ materially in their physiological actions, the latter being much more toxic than the former. From experiments made by Professor Charteris on rabbits, it appears that natural salicylic acid exerts no deleterious effect in ten-grain doses, but that artificial salicylic acid in this dose produces paralysis of the flexors and death. This difference in action depends on the presence in the artificial variety of a substance derived from the carbolic acid from which it is prepared. The nature of this body has not been accurately determined, but it is probably a derivative of

creasotic acid, or an isomeric variation of salicylic acid. Dr. Charteris, who has devoted much attention to the subject, finds that it is the impurity which is responsible for the toxic symptoms so often observed from the administration of the artificial acid. It is found that this substance is more soluble in water than calcium sulphate, and on this fact is based a method of separation, which consists in saturating a boiling solution of salicylic acid with calcium carbonate, and allowing the salicylate of calcium to crystallize out. This method has been improved by Dr. Charteris, and, thanks to his investigations, pure artificial salicylic acid and salicylate of sodium are now prepared entirely free from toxic properties. Dr. Charteris tested his purified specimens on rabbits, and found that fifteen grains given hypodermically produced no bad effect of any kind.

In using salicylic acid clinically, the greatest care should be taken to see that it is the purified substance which is dispensed. The natural acid should be in large crystals resembling strychnine, but slightly yellowish in colour. The crystals of the purified artificial are similar in shape, but are smaller and whiter.

Salicylic acid arrests putrefaction of all kinds, and prevents the development of bacteria in organic mixtures. A one per cent solution arrests the action of ptyalin on starch, and one part in two thousand of urine prevents decomposition.

Salicylic acid, from its antiseptic properties and its slight taste, is largely used for preserving beer, wine, milk, lime and lemon juice, gum, and other fluids liable to undergo fermentation. The French and Germans have forbidden its use for preserving articles of food, but on what grounds is not known. Its use is permitted in this country, but manufacturers, in their own interest and with a view to

possible legislation, would do well to employ only the purified acid, and not the common commercial variety which is often impure.

In man, salicylic acid, given in large doses, induces symptoms not unlike those of quinism, such, for example, as a sensation of fulness in the head, with a roaring or buzzing noise in the ears. After still larger doses, the chief symptoms are headache, double vision, partial blindness, deafness, and profuse sweating. In full toxic doses the patient suffers from ptosis, strabismus, irregular respiration, extreme restlessness, which may pass into delirium, a slow and laboured pulse, and other indications of grave constitutional disturbance. The fæces are passed involuntarily, and the urine is almost black. The temperature falls to such an extent, that it approaches the temperature of collapse. The skin is covered with a rash which is usually of the urticarial type. There is a good deal of difference of opinion respecting the symptoms observed after the administration of large doses of salicylic acid, a discrepancy that would suggest that the specimens supplied were subject to considerable variation with regard to purity. The symptoms here enumerated are rarely observed with the natural acid, and it is not known that they follow the administration of the purified artificial acid, although undoubtedly they do follow the administration of specimens of the drug which, until recently, were described as purified salicylic acid.

Salicylic acid is eliminated chiefly by the kidneys, the urine assuming a dark green colour, due probably to an increased formation of indican. The urine in patients taking large doses of salicylic acid often contains albumin.

Salicylic acid is of much value as an antiseptic, but is inferior in this respect to carbolic acid. It is not only an antipyretic, but an antiperiodic. It is frequently prescribed

in the treatment of acute rheumatism, but salicylate of sodium is more frequently employed. This, however, is simply a matter of convenience, and there is practically no difference in the action of the two drugs. Salicylic acid soon reduces the temperature and relieves the joint pain, but it will not prevent the occurrence of endocardites or pericarditis, and it is not to be relied on in the treatment of hyperpyrexia.

Quite apart from its employment in acute rheumatism, salicylic acid has many uses. Dusted inside the socks and boots it prevents the decomposition of the sweat, and is usually employed in the following form :—

SALICYLIC ACID POWDER.

Salicylic acid	1 oz.
Powdered starch	½ oz.
Powdered talc	½ oz.

In chronic eczema, an ointment made as follows is useful :—

Salicylic acid	½ dr.
Precipitated sulphur	½ dr.
Resorcin	½ dr.
Lanoline ointment	to 1 oz.

Salicylic acid has long had a popular reputation as a remedy for warts and corns, and the following application painted on the affected parts once or twice daily is efficacious :—

Salicylic acid	2 drs.
Alcohol	2 drs.
Sulphuric ether	5 drs.
Collodion	10 drs.

III. SALICYLATE OF SODIUM.

This salt is prepared by the action of salicylate acid on carbonate of sodium. Five grains of the salt are equivalent to four of the acid.

The somewhat unpleasant sweetish taste of salicylate of sodium may be disguised by syrup of orange flower, syrup of ginger, or liquid extract of liquorice.

The remarks which have been made respecting the purity of salicylic acid, are equally applicable to the sodium salt. If salicylic acid is made from impure carbolic acid, the salicylate of sodium made from it must be equally impure. The only possibility of safety is to use salicylate of sodium, prepared according to the method initiated by Professor Charteris. To use a less trustworthy preparation for internal use is to court failure.

Physiologically it has much the same action as salicylic acid. It often produces a rash on the skin, which usually assumes the form of an erythema or urticaria. The buzzing noise in the ears, which results from its administration in large doses, may be controlled by the addition of fifteen grains of bromide of sodium to each dose.

It increases the secretion of the bile, and renders it more watery. Rutherford describes it as being a very powerful hepatic stimulant in the dog. He says: "The certainty of the action of this substance on the liver led us to use it in many experiments as a sort of test of the excitability of the liver."

It appears in the urine in the form of salicyluric acid.

In some cases large doses of salicylate of sodium have resulted in hæmorrhages of various kinds, such as epistaxis, hæmaturia, and hæmorrhage into the retina. It is probable that these symptoms result from the use of an impure salt. They have not been noted when the purified salt has been employed.

Therapeutically it is largely employed in the treatment of acute rheumatism. Thirty grains of purified salicylate of sodium should be given as soon as the patient comes under observation, and twenty grains every four hours

afterwards. In twenty-four hours the fever will have disappeared, and the joint pain will have been reduced to the minimum. As soon as the temperature becomes normal the dose of the salicylate may be materially reduced, its place being taken by bicarbonate of potassium or some other alkali. Salicylate of sodium does not, as a rule, succeed well in cases of hyperpyrexia. In chronic rheumatism the effect of salicylate of sodium is less marked than in the acute form, although not infrequently it temporarily affords relief. Even in cases of gout it may do good. Haig maintains that much of the value, both of salicylic acid and of the salicylates, is due to its power of facilitating the execution of uric acid by forming with it a compound which is soluble in slightly acid fluids.

There can be no doubt as to the value of salicylate of sodium in the treatment of acute tonsillitis, and if given in full doses it nearly always prevents suppuration. It may be used as a gargle.

In sciatica it ranks above the average of remedies in the treatment of this obstinate disease.

In megrim a dose of phenacetin may be given to "break up" the attack, and in the intervals fifteen grains of salicylate of sodium should be given in a cup of black coffee, twice a day.

To prevent any possibility of misconception, it may be as well to state that by a "large" dose of salicylate of sodium or of salicylic acid I mean a dose exceeding fifteen or twenty grains every four hours. I do not for one moment believe that salicylic acid used for the preservation of foods or beverages in the proportion of say 0·038 per cent. is capable of exerting any prejudicial effect on the animal economy, even if taken freely for many weeks in succession. To say that because salicylic acid is used as a local application for corns it must of necessity be harmful even in the smallest possible dose is to my mind an utter absurdity.

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[redacted]

PHARMACOLOGY

OF

DRUGS OF VEGETABLE ORIGIN.

[redacted]

ACONITE.

1. Introduction.

By Aconite, we mean the root, fresh leaves and flowering tops of *Aconitum Napellus*, the common Monkshood, Woolsbane or Blue Rocket. It grows wild in many parts of Europe, and in this country is so generally cultivated for ornamental purposes that it is met with in almost every cottage garden. The root somewhat resembles that of the horse-radish, and is frequently eaten with roast-beef with fatal consequences.

Aconite is the *ακόνιτον* of the Greeks, and the *aconitum* of the Romans. It was well known to the ancients, who regarded it as the most virulent of all poisons, and attributed its origin to Hecate, who, they declared, caused it to spring from the many-headed dog, Cerberus. It is supposed to have been the chief ingredient in the poison cup mixed by Medea for Theseus. It was used in the island of Ceos to carry out the law which condemned to death all who were no longer useful to the state or able to defend themselves. It was long employed as an arrow poison, both by the Chinese and the less civilized of the hill tribes of India. The celebrated Baron Störck, of Vienna, introduced aconite into medical practice in 1762, and Fleming's essay on its physiological action and therapeutic uses—to which the Senatus Academicus of Edinburgh awarded the Gold Medal in 1844—did much to bring it into note. Schmiedeberg

says, "the rather numerous empirical indications for the application of aconite given in past times, have for the present been entirely given up in Germany," and adds that it can now be considered without hesitation as an obsolete remedy. This may be true of Germany, but it is not true of England, where it has been steadily increasing in favour, and is regarded by our best clinical observers as one of the most valuable remedies at their disposal.

2. Active Principles.

The active principle of aconite is usually said to be aconitine or aconitina, formerly known as aconitia. It is an alkaloid obtained not only from *Aconitum napellus*, but from other species of aconite. It is met with in white, generally amorphous, irregular lumps, but may be obtained in acicular crystals. It is soluble in four thousand parts of water, in ether, dilute acids, and rectified spirit. Like other alkaloids it forms salts with acids. Another principle is described under the name of napelline, and there is an acid called aconitic acid.

Considerable doubt still exists as to the meaning which should be attached to the word aconitine.* Commercial aconitine is not a simple substance, but is a mixture of several alkaloids. Binz of Bonn, at the International Medical Congress, held in London in 1881, stated that there was no definite chemical compound sold under the name of aconitine, the various preparations obtainable in England, France, Switzerland, and Germany differing so much in character and composition, that any results obtained by experimenting with them were applicable only to the particular sample employed, and not to aconitine in general. Flückiger and Hanbury, in their "Pharmacographia," state

* Murrell, *British Medical Journal*, 1882. Vol. i. p. 555.

that commercial aconitine is a mixture of aconitine, pseud-aconitine, picraconitine, and other substances. Wright apparently recognizes three alkaloids obtained from different species of aconite, aconitine from *Aconitum napellus*, pseud-aconitine from *Aconitum ferox*, and japaconitine from one or more Japanese species. It is doubtful whether our aconitine is obtained from *Aconitum napellus*, from *Aconitum paniculatum* (which both Flemming and Christison found to be inert), from *Aconitum ferox* (the Bish poison), or from the Japanese species. The statement contained in the *British Pharmacopœia* respecting the origin of the alkaloid, must be accepted for what it is worth; but in reality we do not know whether our aconitine is aconitine proper or pseud-aconitine or japaconitine, or a mixture of all three. Cleaver and Williams stated at the Pharmaceutical Society that extract of aconitine was frequently made from *Aconitum paniculatum*. Mr. Holmes found that a large proportion of the aconite root sold as *Aconitum napellus* was in reality Japanese aconite, and he stated that *Aconitum ferox* was often employed in this country in the preparation of the alkaloid.

It is generally considered that the English aconitine is at least seventeen times as active as the German, the French being intermediate in power; but this classification into English, French, and German is clearly unreliable and unscientific. Professor Pflugge, of Gröningen, investigated the physiological action of seven different kinds of aconitine, and considered that they might be arranged in the following order of increasing activity:—(1) Friedländer (Trommsdorf, of Erfurt); (2) Schuchart; (3) Merck, of Darmstadt; (4) Hopkin and Williams; (5) Hottot, of Paris; (6) Morson; (7) Petit.

This list is obviously incomplete, no mention being made of Duquesnel's crystallized aconitine, which is said to be more active than any of the amorphous varieties. Pflugge

finds that Merck's aconitine is from twenty to thirty times as active as that of Friedländer, whilst Petit's is eight times as active as Merck's. It must be remembered that this is not a mere matter of curiosity, but is of considerable practical importance, several cases of poisoning having occurred from the substitution of one kind of aconitine for another. Desnos records the case of a gentleman, the subject of aortic disease, who suffered from severe anginal attacks. With the view of affording him relief, his medical advisers prescribed Hottot's granules of aconitine. The chemist to whom the prescription was taken substituted for the special aconitine which had been ordered, an aconitine which he happened to have in stock, the source of which was not known, but which was probably of German origin. Gradually, by the advice of the physicians, the dose was increased to four granules a day. The quantity was taken daily for several days with marked relief to the anginal attacks, and without producing any bad symptoms. At last the chemist, having exhausted his original stock, went to Hottot's for a further supply. On the following day the patient, after taking the usual number of granules, which, unknown to him, had been prepared with the new aconitine, suddenly presented alarming symptoms of poisoning: pains in the head, vertigo, loss of voice, great muscular weakness, pallor of the face, anxiety, weakness of the pulse, failure of the heart's action, a tendency to fainting, coldness of the extremities, and profuse perspiration. The respiration was feeble, irregular, short, and sighing. The patient was, in fact, in a most critical condition, and it was many hours before he was out of danger. In another case investigated by Pflugge and Huisinga, the patient was killed outright by the substitution of Petit's nitrate of aconitine for Friedländer's, which the physician had intended to prescribe, but had neglected specifically to indicate. In Germany,

Busscher has recorded three cases of poisoning by French aconitine. In one case which terminated fatally, the dose was prescribed by a physician who was under the impression that the French and German aconitines were identical.

3. Preparations.

There are two preparations for internal administration and two for external use. They are:—

1. Extractum aconiti—extract of aconite.
2. Tinctura aconiti—tincture of aconite.
3. Linimentum aconiti—liniment of aconite.
4. Unguentum aconitinæ—ointment of aconitine.

The extract consists of the fresh juice reduced to the condition of a solid by evaporation. It is a green extract, and is prepared from the green parts of the plant, the leaves and flowering tops. It is an unreliable preparation, and is not much used.

The tincture is prepared from the root, and its strength is about one in eight. The dose, as given in the Pharmacopœia, is from five to fifteen minims, but this is too much. In practice half a drachm is added to four ounces of water, and of this mixture a tea-spoonful is given every quarter of an hour for an hour, and subsequently hourly for six hours, or until the acute symptoms are relieved. It can also be obtained in the form of tabloids, each containing one drop of the tincture, but these are not official. The old Fleming's tincture is about six times as strong as the tincture of the Pharmacopœia. Drop by drop it is as poisonous as prussic acid.

The liniment is a fairly good preparation and contains camphor.

The ointment is a preparation, not of aconite, but of its alkaloid, aconitine. It is called unguentum aconitinæ, and not unguentum aconiti. It rapidly produces tingling

and numbness of the parts into which it is rubbed. The patient should be told to use a piece not larger than a small bean. Care must be taken not to rub it into the eyes or mouth, and to avoid abraded surfaces, or enough may be absorbed to produce constitutional symptoms. It is an expensive preparation, and should not be prescribed *ad libitum*.

Most liniments used as "pain killers" contain aconite. Some time ago I published the result of an analysis of "St. Jacob's Oil." It contains turpentine, ether, alcohol, carbolic acid, capsicum, aconite, and a small quantity of origanum, probably employed for scenting purposes. The percentage composition will be found in the *British Medical Journal*, May 5, 1894; but without going into all the figures it may be said that turpentine, with traces of camphor, constitutes nearly 82½ per cent.

A good formula for a neuralgia liniment is the following:—

Aconitine (B.P.)	1 gr.
Essential oil of mustard	1 dr.
Glycerine	1 oz.
Rectified spirit	to 6 ozs.

It is for external application only, and care should be taken to label it "Poison."

4. Physiological Action of Aconite.

1. *General effects on man.*—Given internally aconite induces a warm and pungent sensation in the parts with which it comes in contact. Tingling of the lips and tongue is soon perceived; the tongue and uvula feel as if swollen, and deglutition is performed frequently. A large dose induces tingling and numbness of the whole body, accompanied by diminished sensibility and muscular weakness. The most sensitive parts are affected first, the tongue and

lips, the tips of the fingers, the perineum, the breasts, the abdomen, and lastly the back. There is great dyspnœa, and breathing is shallow and laboured. The dyspnœa depends to a considerable extent upon the feebleness of the circulation and the consequent imperfect nutrition of the nerve centres. The skin is cold and covered with profuse sweat. The countenance is anxious and sunken, and the eyes are protruded. These symptoms are due to the effects of imperfect respiration. The pupils are dilated, but when there are convulsions they may be contracted. The temperature falls 2° F. or more, and there may be rigors or convulsions. Death often occurs suddenly, especially after some movement or exertion, such as sitting up in bed. Delirium may be observed, but usually the mind is clear to the last. Muscular weakness is always a prominent symptom, and blindness, deafness, and loss of speech are not uncommon as the case approaches a fatal termination.

2. *Action on the heart.*—Moderate doses of aconite reduce the number of the heart's pulsations, which may fall even to forty in the minute. Large doses often temporarily increase the frequency of the heart's beat, but in either case the pulse becomes weak and irregular. The topical application of a solution of aconitine to a frog's heart arrests it in diastole. The large, distended black heart of aconite is characteristic, and presents a marked contrast to the small, pale, firmly contracted heart of digitalis. Aconitine produces this effect on the extirpated heart of the frog, and also when the pneumo-gastrics are paralyzed by atropine or cut, showing that it acts either on the muscular substance of the heart itself or on its motor ganglia. It is thought that, in addition, in mammals it acts upon the vagus roots in the medulla. Experiments have shown that aconite is a general protoplasmic poison, affecting all the structures of the heart in the order of their development;

first, its ganglia, then its nerves, and lastly its muscular substance. Aconite lowers arterial pressure, and, as it does not affect the vaso-motor centre or nerves, this is evidently due to the action of the heart.

3. *Action on respiration.*—Moderate doses slow the breathing, but large and poisonous doses make it short and hurried. This action is probably due to the direct action of the drug on the respiratory centre, aided by its indirect action in weakening the circulation.

4. *Action on the nervous system.*—Aconite being a protoplasmic poison destroys the functions of all nitrogenous tissues; first, of the central nervous system, next of the nerves, and finally of the muscles. It has, moreover, a special affinity for the sensory nerves. On painting a frog's legs with a strong solution of aconitine the nerves are paralyzed, so that on pinching the leg no movement is excited, although the animal can hop about as actively as ever.

5. *Action on the muscles.*—As aconite is a general protoplasmic poison, the muscular suffers in conjunction with the other tissues. The heart muscle is affected, for after death it fails to respond to electrical stimulation.

6. *Action on the skin.*—In frogs poisoned with aconite a peculiar frothy condition of the skin is noticed. Sometimes the froth is so abundant that it completely covers the animal. This condition is not produced by any other drug—not even by pilocarpine. It is quite distinct from the desquamation due to arsenic.

Aconitine is eliminated with the urine and fæces.

The tingling of the tongue produced by aconitine was an important piece of evidence in the celebrated Lamson case. Dr. Stevenson and Dr. Dupré both stated that, when a very minute quantity of an extract of the contents of the stomach containing this alkaloid was placed on the tongue, it

produced a burning sensation which extended to the lip, although the extract did not touch the lip. The character of the sensation was a burning, tingling kind of numbness. It produced an increased secretion of saliva, a desire to expectorate, and a sensation at the back of the throat as if it were swelling up. This was followed by a peculiar seared feeling as if a hot iron had been drawn over the tongue, or a strong caustic applied to it. The sensation on the tongue lasted for four hours. Dr. Stevenson, in cross-examination by the late Mr. Montagu Williams, said that the effect on the tongue was characteristic of aconitine, and of nothing else. Veratrine produced quite a different effect on the tongue, delphinine was more like atropine, whilst pipperine had an immediate burning effect. Cocaine was at that time not generally known, and no questions were asked about its action.

5. Therapeutics.

Aconite is an invaluable remedy in the initial stage of all acute febrile diseases. A characteristic example of its power is afforded by the beneficial effects it exerts in the early stages of acute tonsillitis. It must be given in small doses, frequently repeated. Half a drachm of the tincture is added to four ounces of water, and of this a tea-spoonful is given every ten minutes for the first hour, and subsequently hourly for four or five hours. The temperature falls, the pulse is reduced in frequency, the skin becomes moist, the throat is less painful, and, not uncommonly, the patient falls into a comfortable sleep, from which he awakes not only refreshed, but in every way better. In the initial stages of the acute febrile diseases, such as scarlet fever and measles, it helps to bring out the rash, and apparently mitigates the severity of the subsequent symptoms.

Aconitine is very largely used, especially on the Continent,

for internal administration in cases of obstinate neuralgia. It is also employed in the form of "dosimetric granules."

OPIUM.

1. Introduction.

Opium: "The gift of God to suffering humanity, the dread agent of unimaginable pleasure and pain." This is the poetical description; a more prosaic definition is, the dried or inspissated juice of the unripe capsule of *Papaver somniferum*, hardened in the air.

There are two official species of poppy:—

1. *Papaver rhœas*—the red or corn poppy, which is indigenous and grows wild in fields and waste places.

2. *Papaver somniferum*—the garden or opium poppy, a native of Syria and Egypt, but extensively cultivated in this country.

The fresh petals of the red poppy are used in the preparation of the syrupus rhœados or syrup of red poppy. It has little, if any, physiological action, and is employed as a colouring agent. Its colour is heightened by the addition of acids. It is from the *Papaver somniferum*, cultivated in Egypt, Persia, Asia Minor, and India, that we obtain our opium.

The word "opium" presents some points of interest. In a primitive sense it signified any juice (ὀπός = succus). There was formerly a class of remedies known as "opiata," which did not of necessity possess narcotic properties, and into the composition of which the juice of the poppy in no way entered. The word opoponax is derived from ὀπός and πάναξ, the latter being the name of the plant which yields it. It is not uncommon to find a word which was originally

used to express general characters subsequently applied to some specific substance possessing these characteristics in a pre-eminent degree. The word 'Αρσενικον, from which arsenic is derived, was applied originally to all substances of a very active and poisonous nature. In a similar manner "verbena," or "herbena," was applied to all herbs held sacred in the rites of the sacrifice, although now it is used to indicate the plant in particular. "Vitriol" in its original application denoted any crystalline body having a certain degree of transparency. The term "bark" is used for the particular bark of all others most largely employed in medicinal practice. "Elaterium" was used by Hippocrates to signify any medicines given internally, especially those possessing purgative properties, and was not, as now, confined to the juice of the squirting cucumber.

2. Active Principles.

Opium contains alkaloids—of which there are seventeen all told—neutral bodies, and acids.

The Alkaloids of Opium.—The most important of these, and the most commonly employed, is—

1. Morphine, or morphia, discovered by Sertüner in 1804. It is to the presence of this alkaloid that the chief effects of opium are due. Its chemical formula is $C_{17}H_{19}NO_3$. It may be amorphous, or it may be crystalline. It is soluble in alcohol, and slightly soluble in ether and in water. Good opium yields from six to twelve per cent. of morphine. It is combined naturally with meconic acid, but forms other salts, of which the following are the most important:—

(a) The acetate, met with as a white powder or in fine needles. It is soluble in water and in alcohol. At ordinary temperatures it dissolves in $2\frac{1}{2}$ parts of water. It is from this salt that the injection is prepared.

(*b*) The hydrochlorate, which occurs in plumose crystals. It is less soluble than the acetate, requiring twenty-four parts of water to dissolve it.

(*c*) The sulphate, which is in white acicular crystals. It is a stable salt, and dissolves in twenty-three parts of water. It is the favourite salt in the United States.

Derived from morphine is the hydrochlorate of apomorphine. Apomorphine is not an alkaloid *contained in* opium, but is a derivative of morphine. The hydrochlorate is made by heating morphine or codeine for some hours in a sealed tube with hydrochloric acid. The morphine loses one molecule of water, and undergoes an entire change in physiological action.

2. Codeine, or codeia, discovered in 1832, is the second most important alkaloid of opium. It is contained in the opium, and is not derivative. It is the methyl ether of morphine, and can be prepared artificially from morphine. It is in colourless octahedral crystals, soluble in hot water. From a quarter to one per cent. can be extracted from good opium. Codeine, like morphine, combines with acids and forms salts, but they are rarely employed. There is a derivative of codeine known as apocodeine. It is said to be prepared by removing one atom of water from codeine, and is analogous in action to apomorphine, and by some authorities is supposed to be identical with it.

Other alkaloids of opium are :—

3. Thebaine, or thebia.
4. Codamine.
5. Cryptopine.
6. Narcotine, or anarcotine.
7. Laudanine.
8. Papaverine.

Some of these are of no practical importance, and are hardly worth remembering.

The neutral bodies contained in opium are:—

1. Narceia.
2. Meconin.

The acids contained in opium are:—

1. Meconic acid, used in the preparation of bimeconate of morphine. It is met with in the form of micaceous crystals, nearly colourless, sparingly soluble in water and freely soluble in alcohol. It is used in making the official Liquor Morphinæ Bimeconatis, a preparation which, judging from the accounts of the Therapeutic Committee of the British Medical Association, is very rarely employed.
2. Thebolactic acid, probably identical with lactic acid.

In addition to these substances opium contains several resins, a variety of gummy extractive and fatty matters, and various inorganic salts.

3. Impurities and Adulteration.

The substances used to adulterate opium are pounded poppy capsules, apricot pulp, figs, stones, sand, clay, bullets, treacle, sugar, and cows' dung. Bullets and cows' dung are at a premium in opium-producing countries.

4. Preparations.

It is not worth while trying to remember the preparations of opium. There are only twenty of them, and they practically remember themselves. In the first place, there is the *tincture* of opium, or laudanum, the commonest of all the preparations, its strength being 1 in $14\frac{1}{2}$. This is a simple and not a compound tincture. There is a compound tincture known as *compound tincture of camphor*, or English paregoric. It is called English paregoric because there is another preparation known as Scotch paregoric, the *ammoniated tincture of opium*. The strength, 1 in $14\frac{1}{2}$, is common to several preparations of opium; for example, the

wine is about the same strength, and so is the *liquid extract*. This is the liquid extract, and not the *solid extract*, which is twice as strong as opium itself. The extract is frequently employed for making pills, but there are three official pills of opium—the *compound soap pill* (1 in 5), the *lead and opium pill* (1 in 8), and the *pill of ipecacuanha and squill* (1 in 23½). Just as there are four pills, including the extract which is used for making pills, so there are four powders. First, there is the *compound opium powder* (1 in 10); then there is the *compound ipecacuanha powder*, also 1 in 10; there is the *compound kino powder* (1 in 20), and there is the *aromatic powder of chalk and opium* (1 in 40), a diminishing series as regards strength. There is one other preparation, the strength of which is about 1 in 14½, and that is the *ointment of galls and opium*, used for piles. There are two other special preparations for the rectum, the *suppository of lead and opium* and the *enema*. Just as there are two special preparations for the rectum, there are two special preparations for the mouth, the *lozenges* and the *confection*, the latter being made up into cylinders about an inch long. Finally, there are two preparations for the skin, the *liniment* and the *plaster*. Twenty in all.

There are one or two points worth mentioning about these preparations.

The compound ipecacuanha powder contains both opium and ipecacuanha, in the proportion of 1 in 10. It is made up with sulphate of potassium. It is often said that this substance is introduced for its laxative effects, and to counteract the constipative action of the opium. This is nonsense, for there are only eight grains in two five-grain pills, far too small a dose to have any effect. The crystals of sulphate of potassium are hard and angular, and they act mechanically in breaking up the other ingredients and ensuring [illegible] in the pill mass, a point of great practical

importance. This powder is called Dover's powder—not after the seaport, as has been stated—but in honour of Dr. Dover, who was a friend and pupil of Sydenham. He made a great deal of money as a privateer in the South Seas, and was subsequently elected a Fellow of the Royal College of Physicians.

Another point to remember is that the wine contains aromatics—cinnamon and cloves, and so on. The old opium wine of the 1864 Pharmacopœia contained none of these bodies, and was frequently used for its anodyne effects on the eye. Elderly physicians, ignorant of the change in the composition of this preparation, still order the wine for this purpose; but if the present official compound is dispensed, the effect on the patient is not of a soothing nature.

5. Unofficial Preparations.

There are several unofficial preparations of opium which call for a passing word of notice.

Sydenham's Laudanum, met with in many of the foreign Pharmacopœias under the name of laudanum Sydenhami, or tinctura opii crocata, contains saffron.

Battley's Sedative, the liquor opii sedativus, was once a favourite preparation, and is somewhat stronger than the tincture—perhaps fifty per cent.

Dalby's Carminative contains opium, oil of peppermint, nutmeg, aniseed, and carbonate of magnesium. The proportion of opium is about one-sixth of a grain to the ounce.

Black Drop, or acetum opii, is four times the strength of laudanum.

Nepenthe is a purified alcoholic solution of meconate of morphine in sherry.

Godfrey's Cordial is a mixture of sassafras, treacle, and laudanum, the strength being half a grain to the ounce.

Chlorodyne is not strictly a preparation of opium, but

contains muriate of morphine (the hydrochlorate), prussic acid, chloroform, ether, rectified spirit, extract of liquorice, and peppermint, the usual strength being two and a half grains to the ounce.

Mrs. Winslow's Soothing Syrup is said to contain morphine with essence of anise and syrup of tolu.

It is usually supposed that the preparations of poppy capsules contain opium, but on this point there is no definite evidence. The subject is under investigation.

6. Physiological Action of Opium and Morphine.

When taken in small doses opium produces a condition of excitement, evidenced by the pulse being fuller and quicker, and by the surface of the skin becoming warm and flushed. During the prevalence of this stage the patient has the power of directing his energies in any required direction. For example, if he desires to sleep and the conditions are favourable, a repose of mind and body ensues which is eminently conducive to this end. If, on the other hand, he wishes to work, to write or study, or compose, or what not, he can do so with increased ease and power, accomplishing feats which, to him in the normal condition, would be difficult or, perhaps, impossible. His imagination is more vivid, his thoughts flow more rapidly, and his powers of expression are enhanced.

The pulse in this stage is at first slightly quickened, but it soon resumes its normal rate, although it remains stronger and more resistant.

The mouth and pharynx become dry, and there is often a slight access of perspiration.

The after effects are headache, constipation, dry tongue and loss of appetite.

With still larger doses the stage of excitement is brief, and is followed by profound sleep, from which the patient

can still be aroused. During the stage of sleep the brain is anæmic, both arteries and veins being contracted. After very large doses the primary excitement is almost absent. Giddiness and a sensation of oppression ensue, followed by an irresistible craving for sleep. There may be nausea and even vomiting. The sleep passes into profound insensibility, and the breathing becomes slow and shallow. The pulse, at first full and strong, becomes small, feeble and thready; the face is pale or livid and bloated, and the veins are swollen. The power of swallowing is gradually lost, the pupils become contracted to a pin's point and insensitive to light, the muscles relax, and the patient cannot be roused. Opium diminishes the action of all the secretory and excretory organs, with the exception, perhaps, of the skin. It arrests the powers of digestion, and causes constipation. Given in small doses, in combination with ipecacuanha, it acts as a mild diaphoretic.

In exceptional cases both opium and morphine produce a rash on the skin, accompanied by intense itching. The "pruritus opii" has been frequently noticed, and is described as an annoying and unbearable affection. The rash presents a scarlatinaform appearance, and even the mouth and throat may be attacked by erythematous inflammation.

In frogs the functions of the nerve centres are abolished in the order of their development. They have no higher centres to speak of, and they consequently escape. Their cords, however, are active, and the tetanizing alkaloids, such as thebaine, make their influence felt, the animal being thrown into powerful convulsions.

Birds are peculiarly insensitive to the action of opium, but morphine induces a fall of temperature, often amounting to five degrees or more.

It is usually stated that on dogs morphine acts very much as upon man, eight or ten grains inducing profound

sleep, amounting almost to coma; but recent observations show that dogs are but slightly susceptible to the action of this alkaloid. H. C. Wood and David Cerna gave a dog, weighing 15½ kilogrammes, a dose of 2·4 grammes (37 grains) of morphine without affecting its respiration. Caldwell gave a dog 17 grains without producing serious symptoms, whilst to a number of other dogs he gave 12 grains hypodermically with no bad effect. Dogs usually vomit when the morphine is given by mouth.

It is said that in rabbits doses of morphine, which given hypodermically produce profound narcosis, have no effect if administered by mouth. In one instance a rabbit took five grains of morphine apparently without any effect, but a grain of the alkaloid administered hypodermically produced narcosis.

A horse will take as much as thirty-six grains of morphine, and after a prolonged sleep recover.

There is a difference undoubtedly between the action of morphine on man and on the lower animals, a difference which depends on the immensely higher cerebral organization of the former, rendering him infinitely more susceptible to the cerebral action of the drug.

Morphine is eliminated chiefly by the bowels, to a smaller extent by the urine, and still more slightly by the saliva. The man who would use the stomach in a case of poisoning by the hypodermic injection of morphine would by most people be set down as an ignoramus; but he would be right, for it has been shown experimentally that when the drug is administered subcutaneously, much of it is eliminated by the stomach—in fact by repeatedly washing out the stomach more than half the quantity of the drug injected may be recovered.

There are many circumstances which modify the action of opium and morphine.

1. *Age* is undoubtedly an important factor, children being much more easily affected by preparations of opium than are adults. In this respect it presents a marked contrast to belladonna and other members of the same group, which are readily taken by young people without the production of physiological symptoms. Opium has to be given with great care to infants, even a few drops of laudanum, added to a linseed meal poultice and applied to the chest, sufficing to induce symptoms of poisoning.

2. *Tolerance*, or custom, is another important factor. In Turkey and other Eastern countries where the use of wine is prohibited by the established religion, it is consumed in immense quantities, either mixed with rich syrups and the juice of fruits to make it more palatable, or in small lozenges made up with spices and stamped with the words, *Masch Allah*, "the gift of God." People who are in the habit of taking opium are not affected by even very large doses. De Quincey, for example, took as much as three hundred and twenty grains a day, and could drink laudanum by the tumblerful. The custom of opium eating is very common in many parts of England, especially in the fen districts. Opium smoking has of late become a favourite amusement with ladies of fashion, and the opium pipe is in constant requisition. The preparation employed is the solid extract of the Pharmacopœia.

3. *Race* is not without influence, the Malays, for example, bearing it badly, and being excited by it to a condition bordering on mania.

4. *Elimination* has undoubtedly much to do with the effects produced. When the kidneys are diseased it is not readily eliminated, and symptoms of poisoning may suddenly make their appearance. It has been laid down as a rule that opium should not be given in Bright's disease or in bronchitis, and this, with certain modifications with respect to dose, may be taken as correct.

7. Physiological Action of Codeine.

Codeine differs chemically from morphine in having the radical methyl (CH_3) replacing an atom of hydrogen, a change which can easily be made artificially. It loses much of its hypnotic power, but as a compensation does not act as an astringent and does not interfere with the function of the liver.

Codeine on man has a hypnotic action, which is far inferior to that of morphine. Some patients will take as much as fifteen grains daily without becoming somnolent. It contracts the pupils. Its most marked action is on the nerves of the abdominal viscera. When given for several consecutive days it lessens the irritability of the digestive tract to such an extent that arsenic produces neither vomiting nor purging. In large doses it induces intense irritation of the sensory nerve endings. In a case of poisoning, persistent itching of the skin, lasting for two days, was a prominent symptom. It increases the irritability of the spinal cord, and in frogs produces languor, succeeded by convulsions and paralysis.

In rabbits it produces well-marked but not very deep narcosis. On increasing the dose the reflexes are found to be greatly exaggerated, whilst on further increasing the dose tetanus is induced, the animal dying in convulsions. In dogs narcosis is readily induced by small doses, but the animals suffer from salivation, vomiting, and diarrhœa.

Codeine was at one time supposed to be preferable to morphine in the treatment of diabetes, but there is no good clinical evidence in support of this view.

Codeine may be used with advantage in the treatment of the cough of phthisis, especially the hacking, irritable cough unattended with much expectoration. The following is suggested as a useful formula:—

Codeine	4 grs.
Dilute hydrochloric acid	$\frac{1}{2}$ dr.
Spirit of chloroform	$1\frac{1}{2}$ drs.
Syrup of lemons	1 oz.
Water	to 4 ozs.

Make a linctus. A tea-spoonful frequently when the cough is troublesome.

The "glycerine and codeine jelly" is by no means a bad preparation.

8. Physiological Action of Thebaine.

Thebaine is a tetanizer, and is allied in physiological action to strychnine and brucine. It is a powerful poison, and a tenth of a grain will produce well-marked symptoms in a frog. The convulsions are of spinal origin, as they occur after section of the cervical cord. Thebaine exerts no action on the motor or sensory nerves, nor on striated muscular tissue. Its physiological antidote is chloral.

9. Physiological Action of Anarcotine.

This substance was originally named "narcotine" by its discoverer Derosne, but as this designation is singularly inappropriate and misleading, it has been renamed anarcotine. It is contained in Smyrna opium to the extent of two per cent. only, whilst Bengal opium contains six per cent. Bengal opium is comparatively poor in morphine, but is rich in anarcotine. Smyrna opium, on the other hand, is rich in morphine and poor in anarcotine. Anarcotine possesses no narcotic properties, but is an antiperiodic, and is used with success in the treatment of malarial and intermittent fevers. In some cases it is but slightly inferior, and in other cases distinctly superior to quinine. It has long been held in India that opium is a remedy for and a protective against malarial infection, and

the remarkable immunity of opium-eaters from diseases of this type is probably due to the presence of this alkaloid. Sir William Roberts has pointed out that in anarcotine we possess an antiperiodic of great power, analogous to but not identical with quinine. In India for several years it was regularly supplied from the Government factories at the rate of about a hundredweight per annum, and considerable quantities of the alkaloid are still to be found in many of the medical depôts in that country. It is insoluble in water, but is soluble in ether and in dilute acids. Its alkaline properties are weak, and its salts are unstable. It may be given in the form of a pill, and according to Garden the dose is from one and a half to three grains.

10. Other Alkaloids of Opium.

The other alkaloids of opium call for but little comment, and comparatively little is known about their physiological actions.

Cryptopine is remarkable from the fact that it dilates the pupil.

Narceine is said to be a hypnotic, and to be more active than morphine. It possesses laxative properties.

Papaverine is said to exert strong narcotic effects without inducing mental excitement.

Many of these statements rest on imperfect evidence.

11. The Habitual Use of Opium.

Much of our knowledge of the effects of opium on the system is derived from the confessions of De Quincey. His description of his initiation into the custom of opium-eating is so graphic that it is often quoted—

"I was necessarily ignorant," he says, "of the whole art and mystery of opium-taking; and what I took I took under every disadvantage. But I took it; and in an hour

—oh, heavens! what a revulsion! what an upheaving, from its lowest depths, of the inner spirit! what an apocalypse of the world within me! That my pains had vanished was now a trifle in my eyes; this negative effect was swallowed up in the immensity of those positive effects which had opened before me, in the abyss of divine enjoyment thus suddenly revealed. Here was a panacea, a φάρμακον νηπενθὲς, for all human woes; here was the secret of happiness, about which philosophers had disputed for so many ages, at once discovered; happiness might now be bought for a penny, and carried in the waistcoat pocket; portable ecstasies might be had corked up in a pint bottle, and peace of mind could be sent in gallons by the mail-coach."

That the dreams which follow indulgence in opium are not always of a pleasant character is abundantly evident from De Quincey's description. He says:—

"I was stared at, hooted at, grinned at, chattered at by monkeys, parroquets, by cockatoos. I ran into pagodas, and was fixed for centuries at the summit, or in secret rooms: I was the idol; I was the priest; I was worshipped; I was sacrificed. I fled from the wrath of Brama through all the forests of Asia; Vishnu hated me; Siva laid wait for me. I came suddenly upon Isis and Osiris; I had done a deed, they said, which the ibis and crocodile trembled at. I was buried for a thousand years in stone coffins with mummies and sphinxes, in narrow chambers at the heart of eternal pyramids. I was kissed with cancerous kisses by crocodiles, and laid confounded with all unutterable slimy things amongst reeds and Nilotic mud."

It is often said that habitual indulgence in opium induces a physiological condition very similar to that which results from the abuse of alcohol, but this is not the case. On this point De Quincey is most explicit. He says:—

"Opium, I affirm peremptorily, is incapable of producing any state of body at all resembling that which is produced by alcohol, and not in *degree* only incapable, but even in *kind;* it is not in the quantity of its effects merely, but in the quality, that it differs altogether. The pleasure given by wine is always mounting and tending to a crisis, after which it declines; that from opium, when once generated, is stationary for eight or ten hours: the first, to borrow a technical distinction from medicine, is a case of acute, the second of chronic pleasure; the one is a flame, the other a steady and equable glow. But the main distinction lies in this, that whereas wine disorders the mental faculties, opium, on the contrary (if taken in a proper manner), introduces among them exquisite order, legislation, and harmony. Wine robs a man of his self-possession, opium greatly invigorates it. Wine unsettles and clouds the judgment, and gives a preternatural brightness, and a vivid exaltation, to the contempts and the admirations, to the loves and the hatreds of the drinker; opium, on the contrary, communicates serenity and equipoise to all the faculties active and passive, and with respect to the temper and moral feelings in general, it gives simply that sort of vital warmth which is approved by the judgment, and which would probably always accompany a bodily constitution of primeval or antediluvian health. Thus, for instance, opium, like wine, gives an expansion to the heart and the benevolent affections; but then with this remarkable difference, that in the sudden development of kind-heartedness which accompanies inebriation, there is always more or less of a maudlin character which exposes it to the contempt of the bystander. Men shake hands, swear eternal [illegible]ship, and shed tears, no mortal knows why, and the [illegible]ture is clearly uppermost. But the expansion [illegible]r feelings incident to opium is no febrile

access, but a healthy restoration to that which the mind would naturally recover upon the removal of any deep-seated irritation of pain that has disturbed and quarrelled with the impulses of a heart originally just and good."

Speaking of the effects of alcohol, De Quincey says :—

"Wine constantly leads a man to the brink of absurdity and extravagance, and beyond a certain point it is sure to volatilize and to disperse the intellectual energies, whereas opium always seems to compose what has been agitated, and to concentrate what has been distracted. In short, to sum up in one word, a man who is inebriated, or tending to inebriation, is, and feels that he is, in a condition which calls up into supremacy the merely human, too often the brutal, part of his nature; but the opium-eater (I speak of him who is not suffering from disease or other remote effects of opium) feels that the diviner part of his nature is paramount—that is, the moral affections are in a state of cloudless serenity, and over all is the great light of the majestic intellect."

That there is anything absolutely characteristic in the appearance of the habitual opium-eater I do not for the moment believe. I have known a good many opium-eaters at one time and another, and there is nothing peculiar about them any more than there is in the case of the man who is an habitual tobacco-smoker. It may now be taken as a settled and generally accepted fact that the habitual use of opium in moderate doses produces no deterioration of intellect, morals, or health. The deterioration, if it exists at all, should be sought for in the limited intellectual capacity of the anti-opium fanatics.

The question whether a person who constantly smokes opium, or who has resource to hypodermic injections of morphine, is capable of making a will or executing an important document has before now engaged the attention

of the Law Courts; but as each particular case must be considered on its merits, and as many other circumstances have to be taken into consideration, there has been no definite ruling on the subject. Many years ago I worked up the literature of opium-eating with a view to giving evidence in the Probate Court in a particular case, but I could find nothing that would induce me to believe that the custom of opium-eating would affect the mental condition to such an extent as to make the victim of the habit incapable of transacting his affairs or of executing a will.

The habitual use of hypodermic injections of morphine is a much more serious matter, although I know of one case in which a lady took an injection twice a day for a period of nearly twenty years without suffering any particular inconvenience. It never made her drowsy, and the only apparent effect was to improve the appetite. When, however, the patient has become a slave to the syringe, steps may be resorted to with advantage to break off the habit.

In slight cases, when the administration of a drug is still in the hands of the medical adviser, the following rules may be found useful:—

1. Do not stop the injections suddenly.
2. Diminish the dose gradually, and without telling the patient.
3. Do not give morphine alone, but combine it with atropine.
4. Diminish the dose of morphine, and increase the dose of atropine until the effects of the latter predominate. When the full effects of the atropine are experienced, the patient will complain that the injections have lost their effect, and will ask to have them discontinued.

In more confirmed cases, when the administration of the

drug is in the hands of the patient, the following hints will prove of service:—

1. The patient must give up the custody of the syringe and morphine solution.

2. The dose must be diminished gradually, so as to make but little demand on the moral strength and self-control of the patient. The rate of reduction should not exceed $\frac{1}{16}$ gr. every three or four days.

3. The bowels should be kept well open.

4. Tonics should be given—quinine or nux vomica with capsicum and hydrochloric acid, for example.

5. If the patient cannot sleep, give bromide of sodium in half-drachm doses in plenty of water every night at bedtime. The dose may be repeated if necessary.

6. If the stomach is irritable, or if diarrhœa is a prominent symptom, give carbonate of bismuth in half-drachm doses in milk three times a day. Another good remedy is carbolic acid and tincture of iodine, equal parts, a drop in water three times a day before meals.

7. If much depression, stimulants may be given, but cautiously, and only in measured doses. Dry iced champagne is useful, and so is coca wine.

8. Isolation may have to be resorted to, but it is better to keep your patient occupied and amused. Theatre-going —if a properly ventilated theatre can be found—is a valuable therapeutic agent.

9. Finally the patient must be fed up. A good cook is half the battle.

12. Therapeutics of Opium.

Opium in various forms and preparations is used in the treatment of such a multitude of diseases, that it is no easy matter to give, within a short compass, a detailed account of its therapeutical actions.

Laudanum applied on linseed poultices allays the pain of neuralgia, myalgia, pleurodynia, and of superficial and deep-seated inflammations. It is readily absorbed by the skin, producing its constitutional effects. This mode of treatment must be employed with caution in the case of children.

The extract of opium, smoked in an opium pipe, is used for the relief of asthma, the dyspnœa of emphysema, and allied conditions. It is also said to relieve the pain of neuralgia, and is largely resorted to by women who lead monotonous lives, and have few opportunities of indulging in sexual intercourse. In the form of cigarettes it is smoked to relieve the cough of the early stages of phthisis.

The hypodermic injection of morphine relieves pain and spasm, and in some cases induces sleep. When tolerance is established it improves the appetite and, for a time, stimulates the capacity for mental exertion. One of its most legitimate uses is to relieve the dyspnœa of aneurysm and some forms of cardiac disease. It is probably more useful in mitral than in aortic disease.

For the relief of pain morphine is often given hypodermically, in conjunction with atropine, a useful proportion being half a grain of the acetate or sulphate of morphine with a sixtieth of a grain of sulphate of atropine.

Opium taken habitually by the mouth, acts as an antiperiodic, a circumstance which, to some, explains the large consumption of the drug, both in India and in the fen districts of England.

Laudanum and other preparations of opium are given to check diarrhœa. In obstinate cases an opium enema, containing fifteen minims of laudanum, may be injected into the bowel, with an ounce of decoction of starch.

An opium or morphine suppository is often inserted into the bowel to quiet the intestinal movements after operations. The official suppository contains half a grain of the

hydrochlorate of morphine, and it is quite an open question if this is not too much to employ with safety; at all events, there is a general consensus of opinion that this drug acts much more powerfully when introduced into the bowel than when given by the mouth.

The ointment of galls and opium was at one time largely employed as an application to external piles, but of late it has been, to a very great extent, superseded by the different preparations of hamamelis.

Ten grains of Dover's powder—made up into two pills—will check the profuse night-sweating of phthisis.

APOMORPHINE.

1. Origin.

The discovery of apomorphine is usually ascribed to Matthiessen and Wright, although there is reason to suppose that they were to some extent forestalled by Arppe. At a meeting of the Royal Society, held on June 10, 1869, Mr. Augustus Matthiessen and Mr. C. R. A. Wright read a paper received on May 6th of the same year, "On the Action of Hydrochloric Acid on Morphine," and in this communication they gave particulars of the mode of preparing a substance, for which they proposed the name of "apomorphia." It is not necessary to give all the details of their method, but it practically amounted to this, that they took some morphine, sealed it up in a tube with a large excess of hydrochloric acid, and kept it at a temperature of from 140° to 150° for two or three hours. On breaking open the tube it was found to contain the hydrochlorate of the new base apomorphine. It was purified by dissolving in water, adding an excess of bicarbonate of sodium, and extracting the precipitate with ether or chloroform. On shaking up the solution with hydrochloric acid the sides of the vessel

became coated with crystals of the hydrochlorate. These were drained from the mother liquor, washed with cold water, recrystallized from hot water, and dried on bibulous paper, or over sulphuric acid. This was the way in which they originally obtained their apomorphine; but they found on further investigation that the new base might also be prepared by digesting morphine with excess of hydrochloric acid for some days on a water bath under paraffin.

In this process the morphine loses a molecule of water, and becomes converted into apomorphine (morphine, $C_{17} H_{19} NO_3 = H_2O + C_{17} H_{17} NO_2$, apomorphine).

They found that apomorphine might also be obtained by heating codeine and hydrochloric acid according to the formula (codeine, $C_{17} H_{17} (CH_3) HNO_3 + HCl = CH_3Cl + H_2O + C_{17} H_{17} NO_2$, apomorphine). It is probable that in this reaction there is an intermediate product, but with this we are not for the moment concerned.

These same observers showed that apomorphine was formed when morphine was heated with dilute sulphuric acid in sealed tubes for some hours at a temperature of from 140° to 150°. This is pretty much what was done nearly a quarter of a century previously by Arppe; his product, which was probably an impure sulphate of apomorphine, being subsequently named by Laurent and Gerhardt "sulphomorphide."

2. Preparation.

There is only one preparation of apomorphine in the Pharmacopœia, a one in fifty solution of the hydrochlorate. It is called the injectio apomorphinæ hypodermica, although it is employed quite as frequently in cough mixtures and linctuses as it is subcutaneously. When the emetic effect is required it is injected under the skin, whilst for its expectorant action it is given by mouth. It is made with camphor

water, which is an undesirable medium. It rapidly turns green on exposure to the air, but undergoes no change in physiological action. The direction that it should be prepared as required for use is unnecessary and misleading, as it retains its properties unimpaired for at least a year. In cases of poisoning the solution is required at once, and there is no time to send to a chemist to get it made up.

3. Action and Uses.

Apomorphine is a powerful emetic, and is extensively used for that purpose. A dose of a tenth of a grain given hypodermically—five minims of the injectio apomorphinæ hypodermica—speedily evacuates the contents of the stomach. It is of much value in cases of poisoning. It is not in any way allied to morphine, and may be used with advantage in cases of narcotic poisoning. Given in this dose it rarely produces collapse, and may be employed with perfect safety. In addition to being a powerful emetic, it is a valuable expectorant. In doses of a tenth of a grain three times a day by mouth, it facilitates the expectoration of phlegm, and does not induce vomiting. Even as much as twenty minims of the official solution (one in fifty) may be given frequently with perfect safety. It stimulates the respiratory and vomiting centres and increases the secretion of bronchial mucus.

Why apomorphine should act as an emetic when given hypodermically, and as an expectorant when administered by mouth, is a subject which has often been discussed. It is, I think, simply a question of the rapidity of absorption. With the view of testing the question of the rapidity of absorption I administered in the form of an ointment what would be an emetic dose of apomorphine if given hypodermically. I had three specimens prepared, one with lard, one with vaseline, and one with lanoline, each containing

one-tenth of a grain to the drachm. They were given to three different patients, with instructions that they should be rubbed into the chest before the fire at bedtime. They produced no emetic effect. The strength of the ointment was then increased in each case to one-fifth of a grain, and the result was the same. I subsequently employed an ointment containing a grain of apomorphine mixed with an ounce of lard or lanoline, directing the patient to rub in half the quantity on two consecutive nights. It acted as an expectorant, the effect lasting for some hours, but it induced no nausea. I repeated this in several cases, and the result was always the same. I presume that the fact of the drug being comparatively slowly absorbed affords an explanation of what at first sight appears an anomalous result. Practically it is a decided advantage to have at our disposal a drug which may be relied on to induce an expectorant effect when used in the form of an ointment. In the case of children suffering from bronchitis this mode of treatment is of much value.

There is no reason why apomorphine should not be given in combination with morphine. Rossbach speaks highly of this mixture in the treatment of phthisis, and says that it lessens the frequency of the cough and increases the fluidity of the sputum. Lauder Brunton says:—"When apomorphine and morphine are given together, they do not destroy each other's action, so that from the combination we get increased secretion from the mucous membrane, with diminished irritability of the respiratory centre and consequently lessened cough. The cases in which the combination is useful are those where there is difficulty in breathing, continual cough, and thick tenacious mucus."

I have also employed apomorphine as a spray, on the lines of the old ipecacuanha wine treatment. I used for its administration a bottle with a conical bottom, the silver tube

reaching to the apex, so that the whole of the solution could be utilized. I took care to observe the recognized precautions in such cases, using a warm solution, making the patient spit out the fluid which accumulated in the mouth, instructing him not to arch his tongue against the roof of the mouth, and making him inspire deeply with every contraction of the air ball. I began with ten minims of the one per cent. solution in a little water for each inhalation, but I now frequently give as much as half a drachm at a dose. The expectorant effect is very marked, especially with the large doses.

The points to remember about apomorphine are :—

1. That although made from morphine, it has no narcotic properties.

2. That given hypodermically it is a powerful emetic.

3. That given by mouth it is the best of all expectorants.

4. That the Pharmacopœia solution is absurdly named, as the "injectio apomorphinæ hypodermica," is more frequently administered by mouth than subcutaneously.

5. That it is not necessary that the solution should be freshly prepared.

6. That a few drops of dilute hydrochloric acid will prevent the solution from turning green.

7. That mixtures containing apomorphine are conveniently flavoured with syrup of tar or syrup of Virginian prune.

8. That apomorphine can be prepared either from morphine or codeine.

9. That there are two doses for apomorphine, the expectorant dose and the emetic dose, just as there are two doses of carbonate of ammonium.

COCA AND COCAINE.

1. Introduction.

By coca we mean the dried leaves of the *Erythroxylon coca*, a shrub growing wild in many parts of South America, but extensively cultivated for medicinal purposes.

The leaves, when matured, are carefully picked by hand so as to avoid breaking them, and they are then dried in the sun. The industry must be a very large one if reliance can be placed on the statement that two million pounds' worth are produced every year.

Coca leaves were used by the aborigines long before their conquest by the Spaniards. They regarded them as a divine gift, and spoke of them as "that heavenly plant which satisfies the hungry, strengthens the weak, and makes men forget their misfortunes." At first the leaves were reserved for religious rites and the use of the sovereign, and to this day they are regarded with superstitious dread by the Indians, who put them in the mouths of their dead to secure them a favourable reception in the next world. They were employed by the Peruvians as a medium of exchange, and on the introduction of a gold and silver coinage, became the chief article of commerce. The Spaniards were at first opposed to their introduction, and the priests promulgated edicts against them, denouncing them as "Elusio del demonio." The prohibition was removed when it was found that they were a source of revenue, and the mine owners recognized their value in sustaining and increasing the productive power of their employés. The earliest account of coca was given by Dr. Monardes of Seville, in 1569, and an English translation of his paper was published in London in 1596.

The dried leaves are chewed by the natives of South

America to sustain strength and appease hunger in the absence of food. The rural postman before starting on his long journeys provides himself with a little bag of the leaves and some finely-powdered lime. When he wishes for a chew he forms a roll of leaves in his mouth with his tongue, moistens a slip of wood, dips it in the lime or in ashes and smears it over the roll of leaves. This brings out the flavour and excites the flow of saliva. It is said that these post-runners carry letters more than a hundred leagues without partaking of food of any kind. Native travellers apparently derive such sustenance from chewing the leaves that they frequently take no food for four or five days, although travelling on foot during the whole time. They say that when provided with a good supply of leaves they feel neither hunger nor thirst, and can without inconvenience remain eight or ten days without sleep. Miners chewing the leaves every three hours, and taking no food but an occasional handful of rice or maize, are enabled to work for twelve hours at a stretch without inconvenience.

It is stated that coca does not destroy the appetite, the proof being that when the work is over they not only enjoy a good meal, but often eat ravenously. It is possible that many of these statements are incorrectly reported and are exaggerated. It is generally admitted that the excessive use of coca is injurious, and that the confirmed "coquero," or chewer, becomes after a time listless, haggard and gloomy, and that he is not altogether a lively companion.

A good deal of attention was attracted to the subject of coca eating in 1876, by the statement that the American pedestrian, Weston, employed the leaves for sustaining his strength in his long walks, and also by the publication of papers on its physiological action by the late Sir Robert Christison, and especially by the late Mr. G. F. Dowdeswell, the latter of whom investigated the matter very thoroughly.

Mr. Dowdeswell's view was that coca was practically inactive. In his paper, published in the Lancet in 1876, he says:—

"Without asserting that it is positively inert, it is concluded from these experiments that its action is so slight as to preclude the idea of its having any value either therapeutically or popularly; and it is the belief of the writer, from observation upon the effect on the pulse, etc., of tea, milk-and-water, and even plain water, hot, tepid, and cold, that such things may, at slightly different temperatures, produce a more decided effect than even large doses of coca, if taken at about the temperature of the body." Whilst not endorsing this expression of opinion, I can speak from personal observation as to the care with which these experiments were conducted.

2. Active Principles.

Cocaine, the chief active principle of coca, was isolated in 1860. It is methyl-benzoyl-ecgonin. Good leaves yield about a half per cent. of the alkaloid. It is soluble in water, alcohol, ether, chloroform, and oil of cloves. It forms salts, of which the hydrochlorate is official.

The alkaloid itself requires more than seven hundred parts of water to dissolve it, but the hydrochlorate is much more soluble, dissolving in half its weight of water. On the other hand, cocaine is soluble in oil of vaseline, in oil of cloves, and in most volatile and fixed oils, whilst the hydrochlorate is insoluble in fats and oils, and should not be prescribed with them.

Cocaine, under favourable circumstances, readily yields derivatives. When heated with mineral acids it is decomposed into benzoic acid, methyl alcohol, and another alkaloid ecgonin.

When cocaine is simply heated in watery solution a less

complete decomposition takes place, the solution depositing on evaporation a crystalline substance called benzol-ecgonin.

The leaves also contain Hygrin, a volatile principle. Some varieties of coca contain another alkaloid, known as cinnamyl-cocaine, whilst a substance called cocamine is also described.

3. Preparations.

There is one official preparation of coca—the liquid extract—and there is one official preparation of cocaine, the discs or lamellæ made up with glycerin and gelatin, and containing $\frac{1}{200}$ of a grain of the hydrochlorate in each. The lamellæ of the Pharmacopœia are useful preparations, and are intended for application to the eye. There are three official lamellæ :—

1. *Lamellæ Atropinæ*, discs of atropine, contain $\frac{1}{5000}$ of a grain of the sulphate in each, and are used for dilating the pupil.
2. *Lamellæ Physostigminæ*, discs of physostigmine, contain $\frac{1}{1000}$ of a grain of physostigmine in each, and are used for contracting the pupil.
3. *Lamellæ Cocainæ*, discs of cocaine, contain $\frac{1}{200}$ of a grain of the hydrochlorate in each, and are used for producing anæsthesia of the conjunctiva and dilating the pupil.

In addition to the official preparation of coca there are various unofficial wines, one of the best known being Mariani's. A good coca wine may be made by macerating the dried coca leaves for six days in any red wine—the proportions being six of the leaves to one hundred parts of the wine. As good leaves cost only about a shilling a pound, there is a cheaper method than buying the advertised preparations, let alone the question of purity.

Cocaine tabloids, containing one-third or one-half of a

grain in each, are largely employed both for internal administration and for local application. They are frequently used in the treatment of sea-sickness, and are efficacious and trustworthy.

4. Physiological Action of Coca.

A general idea of the properties of the drug will have been gathered from the introductory remarks on its history and uses. There is a general consensus of opinion that moderate doses of coca are not hurtful, but are in many cases beneficial. It is said that the drug exerts first a sedative and then a stimulating effect on the higher nerve centres. There may be obtained from coca the pleasurable effects both of caffeine and morphine, the chewer experiencing the soothing effect of the former, and avoiding the disagreeable after consequences of the latter. The complete absence of depression or mental confusion is due to the rapidity with which the period of stimulation succeeds the primary stage. It is probable that coca has the power of diminishing metabolism.

5. The Physiological Action of Cocaine.

The literature of this subject has attained such gigantic proportions that it is no easy matter to cope with it. Niemann, as long ago as 1860, noted the fact that cocaine, when applied to the tongue, produced anæsthesia.

Schroff, in 1862, found that doses of 0·05 grammes administered to rabbits gave rise to disturbance of pulse and respiration, and also produced temporary mydriasis.

Froumüller, a year later, showed that doses of 0·03 to 0.33 grammes caused in man little or no disturbance.

In 1874, Bennett published an experimental inquiry into the physiological actions of theine, caffeine, guaranine, cocaine, and theobromine, and demonstrated that cocaine

exerted its influence chiefly on the sensory nerves, and was an anæsthetic.

In 1876, Ott showed that it dilated the pupil.

These observations, however, appear to have been forgotten; and although various preparations of coca were largely employed as therapeutic agents, the active principle itself was rarely used, and its very existence was unknown to the majority of medical practitioners.

Suddenly, however, the whole aspect of affairs was changed. On Sept. 15, 1884—a date long to be remembered in the annals of therapeutics—Dr. Karl Köller, of Vienna, demonstrated at the Ophthalmological Congress at Heidelberg, the action of a solution of cocaine when applied to the eye. Dr. Köller, it appears, had long been aware that cocaine acted as a local anæsthetic to the larynx, and it occurred to him that similar results might be obtained if used for other mucous membranes. At the Heidelberg Clinic two drops of the solution were dropped into the eye of a patient experimentally, and in a few minutes it was noticed that the sensitiveness of the surface was below normal. A drop or two more and the anæsthesia was complete; a probe was pressed upon the cornea until the surface was indented, it was rubbed over the surface of the cornea, it was rubbed over the conjunctivæ, a speculum was introduced and separated the lids, and they were stretched to their utmost, the conjunctiva was seized with a pair of forceps, and the globe was moved about in various directions, but there was no pain, and the patient declared that he experienced no inconvenience of any kind. Before the experiment the eye had been tested, and was shown to possess the normal sensitiveness; the other eye, which was not treated, remained in this respect perfectly normal. At first a two per cent. solution was used, but subsequently it was increased to four per cent.

A knowledge of this wonderful discovery spread quickly, and in a few days there were hundreds of workers in the field which had been so suddenly opened to them. Cocaine was dropped into the eye and rubbed into the skin, applied to the larynx and pharynx, and even injected into the rectum and vagina. The price of the drug rose rapidly, and physicians were found only too pleased to pay half a crown a grain for the privilege of trying it. Every one seemed anxious to do something to associate his name, in however small a degree, with so momentous a discovery. The result was the publication of a host of papers and articles, many of them displaying only too obviously the signs of haste and crude experimentation.

We have now to consider the present state of our knowledge with regard to the effects of cocaine on special organs and special tissues:—

(1) *On the eye.*—One of the most striking effects of cocaine is the production of anæsthesia of the conjunctiva when applied topically.

This striking property, as we have seen, was discovered by Dr. Karl Köller, of Vienna, in 1884. In his paper he says:—

"A few drops of a watery solution of muriate of cocaine dropped on the cornea of a guinea-pig, rabbit, or dog, or instilled into the conjunctival sac in the ordinary way, cause for a short time winking of the eyelids, evidently in consequence of a slight irritation. After from one-half to one minute the animal again opens its eyes, which gradually assume a staring look. If now the cornea is touched with a pinhead—in which experiment we have carefully to avoid touching the eyelashes—the lids are not closed by reflex, the eyeball does not move, the head is not drawn back as usual, the animal remains perfectly quiet, and on application of stronger irritation we can

convince ourselves of *the complete anæsthesia of the cornea and conjunctiva.* In this way I have scratched and transfixed the cornea of my animals used for experiment with needles, and have excited them with electric currents so strong as to cause pain in my fingers and become quite intolerable in the tongue; I have cauterized the cornea with the nitrate of silver stick until it became milky white. During all this the animals did not move. The last experiment convinced me that the anæsthesia involved the whole thickness of the cornea, and did not affect the surface only. But if I incised the cornea the animals manifested intense pain when the aqueous humour escaped and the iris prolapsed. I have been unable hitherto to decide by experiments on animals whether or not the iris could be anæsthetized by dropping the solution into the corneal wound, or by prolonged instillations into the conjunctival sac, for experiments to test the sensibility of non-narcotized animals are very complicated and difficult, and do not yield unambiguous results. The last question which I subjected to experimentation on animals, viz. whether or not the inflamed cornea could be anæsthetized by cocaine, was answered in the affirmative. The cornea, in which I had previously induced acute keratitis, became as insensible as a healthy one. Complete anæsthesia of the cornea from the use of a two per cent. solution lasts ten minutes on an average. After such successful experiments on animals, I did not hesitate to apply cocaine also to the human eye, trying it first on myself and some of my friends, then on a great number of other persons, obtaining, without exception, the result of a perfect anæsthesia of the cornea and conjunctiva. The course of the phenomena is as follows: If some drops of a two per cent. solution are instilled into the conjunctival sac, or, better still, let run over the cornea, first a slight

burning (accompanied by some lachrymation) is felt, which in from a half to one minute disappears, being followed by a dull sensation of dryness. The eye, like that of the animals mentioned above, assumes a staring look, owing to a considerable dilatation of the palpebral fissure. If now the cornea is touched with the head of a pin no sensation of pain or of contact is experienced and all reflexes are absent. The same holds of the conjunctiva, in which the sensation of temperature is likewise abolished. The scleral conjunctiva can be grasped with a pair of toothed forceps, or a dimple can be made into the cornea by pressure, without any unpleasant sensation or the least reflex on the part of the person thus treated; the only thing he perceives is an indistinctness of objects owing to the curvature of the cornea. This complete anæsthesia lasts from seven to ten minutes, then passes through a longer stage of reduced sensibility into the normal condition. About fifteen or twenty minutes after the instillation the pupil begins to dilate. The dilatation reaches its highest degree within the first hour, decreases considerably in the second hour, and disappears without a trace in a few hours more. The pupil is never *ad maximum* dilated, responds promptly to light and convergence during the whole time, and for that reason the sensation of being dazed, connected with atropine mydriasis, is totally absent or only slightly pronounced."

A very insignificant paralysis of accommodation appears and disappears with the dilatation of the pupil. A two per cent. solution produces no irritation of any kind, and its effects disappear in from fifteen to twenty minutes. When it is required to produce an anæsthetic effect without dilating the pupil, the cocaine is combined with pilocarpine.

(2) *On the mucous membranes.*—Cocaine produces an

anæsthetic effect when applied to any mucous membrane. The cocanized area becomes pale, blanched, and finally almost bloodless, so that the sensory nerves, being deprived of their due supply of blood, cease to communicate impressions. There is first a loss of sensibility to pain, then to changes in temperature, and finally tactile impressions are lost. The nerves of special sense also fail to perform their respective functions. Thus, when cocaine is applied to the mucous membrane of the nose, the appreciation of smell is lost; and in the same way when a solution is painted on the tongue there is loss of taste. The effect, however, is only temporary, and passes off in from twenty minutes to half an hour. It is probable that cocaine acts by paralyzing the terminal twigs of the sensory nerves as well as the sensory end-organs, although, possibly, the effects may be due to a purely vaso-motor action.

(3) *On the skin.*—The action of cocaine on the unbroken skin is much less marked than when applied to mucous membranes, the explanation being that it is less readily absorbed. Local anæsthesia may be induced by injecting the drug hypodermically.

(4) *On the nervous system.*—When taken internally cocaine exerts, first, a stimulating, and then a paralyzing action on the nerve centres. It affects, first, the cerebral hemispheres, next the medulla, and lastly the spinal cord. On painting the exposed motor areas of the brain with a solution of cocaine their excitability is lessened and epileptiform convulsions are produced by the local application of the Faradic current with much greater difficulty than in the normal condition. In large doses cocaine may give rise to fulness of the head, a sense of weariness and restlessness, an inability to control the ideas, often accompanied by giddiness. In the case of dogs, cocaine produces a curious condition of delirium, which may be

described by the word ecstasy. An animal which is habitually calm, quiet, and self-contained, soon after an injection of cocaine will frisk about and display every indication of affection and delight. This continues for some hours until, little by little, the normal condition is resumed. When the dose administered is very large the dog is dejected, and may be seized with an attack of convulsions. It appears that these large doses exert a peculiar effect on the semi-circular canals, due, probably, to the production of anæsthesia of the nerves connected with them. This is shown by rhythmical movements of the head, disturbance of equilibrium, loss of co-ordination, rotary convulsions, and opisthotonos. The convulsions are undoubtedly of cerebral origin, for they cease when the cord is divided.

(5) *On respiration.*—H. C. Wood and D. Cerna have shown that cocaine is in dogs a powerful respiratory stimulant, increasing the amount of air taken into and expelled from the lungs. It exerts this action by a direct influence on the nerve centres which preside over the respiratory movements. In this respect it is allied to strychnine and atropine.

(6) *Minor actions.*—Cocaine contracts the blood-vessels and stimulates the heart, heightening blood pressure.

Cocaine lessens most of the secretions, the saliva, the gastric juice, etc., as shown by impairment of digestive power, and other examples.

The peristaltic movements of the intestines are at first increased, but at length become sluggish.

A slight rise of temperature has also been found to follow the administration of cocaine.

Cocaine is probably eliminated for the most part by the kidneys; and, after large doses, albumin and sugar have been detected in the urine.

6. Therapeutics of Cocaine.

Cocaine has been employed with success in the treatment of a large number of very different morbid conditions.

It is not readily absorbed by the unbroken skin, but a ten per cent. solution in oil of cloves rubbed into the affected part affords relief in neuralgia. When applied to a blistered surface, it anæsthetizes the part. When injected hypodermically in doses of a third of a grain, it produces some local anæsthesia, but the action of the drug does not extend far. This mode of treatment has been found useful in neuralgia, and for the performance of small operations.

When the larynx, uvula and adjacent parts are painted with a twelve per cent. solution, polypi and other growths can be removed without pain. This same solution may be used with advantage in cases of acute and chronic laryngitis.

In acute tonsilitis a four per cent. solution should be used, and if this is applied every hour, the pain and difficulty in swallowing are speedily relieved.

A ten per cent. solution, applied with a brush to the nasal mucous membrane, is an excellent remedy for hay-fever, and even better results may be obtained by introducing a quarter of a grain tabloid into each nostril, allowing it to slowly dissolve in the secretions.

In operating for nasal polypi a four per cent. solution is used, and is applied by means of a pledget of cotton. Catheterization of the eustachian tube through the nose is greatly facilitated by previously applying cocaine to the lower nasal passages and to the pharyngeal orifice of the tube. This can be done by an atomizer, or by a brush, or a small pad of absorbent cotton wool at the end of a probe.

Instillations of cocaine into the external ear canal have been found useful in neuralgic earache. In inflammatory earache in children, a four per cent. solution answers

admirably, a few drops being applied directly to the drum membrane with a speculum and dropper.

Cocaine is useful in dental practice, and it is not a bad plan to paint the gums with a ten per cent. solution before removing tartar from the teeth. The citrate worked up into a little pill and pressed into the cavity of a decayed tooth, is used by dentists in dealing with a sensitive tooth pulp.

In ophthalmology cocaine is of the greatest value. Cataract operations under its influence are performed painlessly and with very little bleeding, whilst operations on the cornea and conjunctiva are much facilitated by cocaine anæsthesia. In squint operations it is usually necessary to inject a few drops of a four per cent. solution by a fine hypodermic syringe through the cocainized conjunctiva into the muscle which it is desired to tenotomize. If in any operation cocaine mydriasis is inconvenient, it may be corrected by the instillation of a drop or two of eserine solution, which will produce full contraction of the pupil without diminishing the anæsthetic effect of the cocaine.

A few drops of the two per cent. solution injected into the urethra will relieve the scalding of gonorrhœa. The bladder should be previously emptied, and the solution should be retained for some minutes.

In the itching of herpes of the penis, cocaine applied locally affords prompt relief.

Cocaine given internally has been found useful in the treatment of the craving for alcohol or morphine, but care must be taken not to prolong its use so as to establish a cocaine habit.

Cocaine is largely employed for the relief of sea-sickness.

JABORANDI.

1. Introduction.

The words jaborandi, jamborandi, and iaborandi are employed in Brazil to denote any tree or shrub possessing the power of inducing sweating and perspiration, a species of pepper, piper jaborandi, or false jaborandi, being especially so designated. Practically, we now employ the term jaborandi—pronounced as if it were spelt with a "y"—to denote the leaves and young shoots of *Pilocarpus pinnatifolius*, a member of the rue family and a native of Brazil. The true leaves are full of pellucid dots, easily recognized by holding the specimen up to the light. The leaves of other species of pilocarpus are frequently imported from Rio Janeiro, but they are much less active. The true jaborandi is a shrub about four feet high, flowering in spring and early summer. It is obtained chiefly in the neighbourhood of Pernambuco, where it grows in the forest clearings and on the slopes of the hills. It has long been employed by the natives as a remedy for snake-bite, and in the treatment of fevers. Early in the year 1874 it was introduced to the notice of the medical profession in Europe by Dr. Coutinho, of Pernambuco, who sent specimens to the late Prof. Gubler, by whom it was tried in Paris.

2. Physiological Action.

When a dose of the infusion or of pilocarpine is given to an adult under favourable circumstances, the face, ears, and neck become in a few minutes deeply flushed—although the flushing is never so intense as with nitrite of amyl—and soon drops of perspiration break out all over the body, whilst at the same time the mouth waters. The perspiration rapidly increases, the sweat running down the body

and soaking the clothes, whilst the salivation becomes so profuse that the saliva pours from the mouth in an almost continuous stream.

Jaborandi promotes other secretions, as the lachrymal, nasal, bronchial, and intestinal, although to a far less extent than the salivary and cutaneous. The eyes water, there is a little running at the nose, and, perhaps, a loose cough. Nausea and vomiting may occur, but they are rarely distressing, and may be obviated by directing the patient not to swallow the saliva but to expectorate it. Sometimes there is a little depression, due to the nausea, but it is transitory.

It is often said that jaborandi is a diuretic, but such is not the case; it is true that after the administration of a full dose the patient experiences a desire to pass water, but this is due to contraction of the bladder, and not to increased action of the kidneys. The proof of this is that the amount of urine voided is very small, often amounting to only one or two ounces. Jaborandi tends rather to diminish the amount of urine secreted in consequence of its diaphoretic action, and certainly is not a diuretic.

It has been stated that jaborandi relaxes the bowels, but this is rarely observed. There is not unfrequently a little frontal headache; but this soon passes off, and the patient becomes drowsy and falls comfortably asleep. After a full dose the sight is a little dim, due possibly to the lachrymation, but there is no alteration in the size of the pupil. It is probable, judging from the analogous action on the salivary glands, that jaborandi stimulates the pancreas, and it is known that it increases the flow of milk. Pilicier noted in a dog with gastric fistula an augmentation of the gastric juice, and Rutherford's experiments have demonstrated that jaborandi is a feeble hepatic stimulant.

Occasionally there is little or no perspiration, and more

frequently salivation is absent; but when the drug fails to produce sweating it acts more powerfully on the salivary apparatus, and *vice versâ*. In a series of experiments (Ringer and Murrell) made on out-patients, it was shown that out of sixty-eight cases both perspiration and salivation occurred in fifty-nine; in five there was perspiration without salivation; and in four there was salivation without perspiration. In by far the greater number of cases both perspiration and salivation were profuse; but sometimes the perspiration or salivation, or both, were slight. When administered on a full stomach the drug is more slowly absorbed, and the effects are less constant.

The sweat produced by a single dose of jaborandi or pilocarpine is often enormous in quantity, amounting not unfrequently to half a pint or more. Usually the chlorides are in excess, the carbonates and phosphates are present in very minute quantities, whilst the urea exists in more than five times the normal proportion, the amount eliminated in a single sweating ranging from ten to fifteen grains. Pilocarpine produces sweating by its action on the peripheral nerve apparatus, and not by any influence on the sweat-centres in the cord.

Pilocarpine given by mouth or hypodermically so as to induce sweating, has undoubtedly the peculiar property of stimulating the growth of the hair. In one case, as the result of the continued use of the drug, the hair became coarser in texture and much darker in colour.

The saliva secreted may measure a pint or even a pint and a half. The salivation is the result of a direct action on the salivary gland itself or on its nerve peripheries, and is produced even after section of all the salivary nerves. In large doses it paralyzes the ends of the secretory nerves, so that irritation of the chorda tympani no longer gives rise to secretion. Langley has shown that in proportion to

the quantity given, pilocarpine paralyzes both the chorda and sympathetic secretory fibres. The diminution of the pilocarpine secretion caused by stimulating the sympathetic, is a direct effect of the diminished blood supply, and not of the nerve fibres inhibitory to the secretion. The slight increase of saliva obtained by stimulating after a large dose of pilocarpine, is due not to the action of its secretory, but of its vaso-dilator fibres.

Pilocarpine is a galactagogue, and is probably the only example of this class we possess. It distinctly increases the secretion of milk in nursing women, a fact which has been demonstrated experimentally. It will be remembered that belladonna and members of that group promptly arrest the secretion of milk.

The influence on the temperature is slight, and there is commonly a slight fall, due to the loss of heat by evaporation.

There is generally a quickening of the pulse, amounting to forty or fifty beats in the minute, accompanied by a slight falling-off in strength.

The flushing of the face is due to dilatation of the arterioles, which may account for the increased rapidity of the heart's action. In frogs the heart is not quickened, but is slowed, and is ultimately arrested in diastole, probably by stimulation of the intra-cardiac inhibitory apparatus.

Locally applied it produces contraction of the pupil and tension of the accommodative apparatus, with approximation of the nearest and farthest points of distinct vision and amblyopic impairment from diminished sensibility of the retina. Pilocarpine is frequently employed as a substitute for eserine.

Jaborandi affects children far less powerfully than it does adults. Compare this with the susceptibility of

children to opium and their insusceptibility to the action of belladonna, atropine, and the other mydriatic alkaloids.

3. Active Principles.

Jaborandi contains four alkaloids:—

1. *Pilocarpine* represents the active properties of the plant, and is a liquid alkaloid like coniine and nicotine. It is a colourless, odourless, syrupy fluid, and, like other alkaloids, forms salts. The nitrate is official. On the Continent the hydrochlorate is preferred, but it is slightly deliquescent and does not keep well in our damp climate.

2. *Jaborine* is possibly a derivative of pilocarpine. It does not form cystallizable salts, and in properties it is antagonistic to pilocarpine, being analogous in action to atropine and other members of that group.

3. *Pilocarpidine* acts like pilocarpine.

4. *Jaboridine* is analogous in action to jaborine.

4. Preparations.

The official preparations of jaborandi are:—

1. Extractum jaborandi.
2. Infusum jaborandi.
3. Tinctura jaborandi.

There is no official preparation of nitrate of pilocarpine, although the salt itself is largely employed.

5. Antagonisms.

A marked antagonism exists between atropine and pilocarpine. Atropine dilates the pupil, pilocarpine contracts it. Atropine dries the skin and mouth, whilst pilocarpine induces perspiration and salivation. A hypodermic injection of a hundredth of a grain of sulphate of atropine will immediately arrest the salivation and perspiration induced by jaborandi or pilocarpine. The antagonism may also be

demonstrated on the frog's heart. The animal having been pithed and the heart exposed, the application of a few drops of a solution of pilocarpine first retards its action and then arrests it in diastole. If now a drop or two of a solution of atropine be applied, the heart almost immediately commences beating, and continues to do so with unabated vigour. It is noteworthy that in man there is in some respects not only no antagonism, but the symptoms produced are similar. They both produce flushing of the face, frontal headache, and a desire to urinate. Atropine checks not only the antagonistic effects of pilocarpine, but also those symptoms which are common to both. Atropine is a much more powerful alkaloid than pilocarpine, and is more markedly antagonistic to pilocarpine than pilocarpine is to atropine. It will be remembered that both drugs act less powerfully on children than on adults.

Hyoscyamus and hyoscyamine also antagonize the action of jaborandi and pilocarpine.

It has been shown experimentally (Ringer and Murrell) that pituri (*Duboisia Hopwoodii*), duboisine (from *Duboisia Myoporoides*), and muscarine (the active principle of poisonous mushrooms) are all antagonistic to pilocarpine in their action on the frog's heart.

6. Therapeutical Uses.

In large doses pilocarpine has been used with advantage in Bright's disease. The drug is usually given hypodermically, and the profuse sweating which it induces often relieves the œdema of the extremities.

In small doses—a tenth of a grain in the form of a pilule—pilocarpine promptly relieves the night-sweating of phthisis.

QUASSIA—CALUMBA—GENTIAN.

1. Introduction.

These are all three stomachics, stomachic tonics or bitters—medicines, that is to say, which are supposed to improve the appetite, assist digestion and prevent flatulence and discomfort.

Other members of the group are chiretta, cusparia, cascarilla, absinthe, and hops. Nux vomica, strychnine, cinchona, and the salts of quinine might perhaps be included in this category; but they are not simple tonic bitters, and have special properties of their own, so that they are more conveniently considered apart.

By quassia we mean the chips, shavings, turnings and raspings of *Picræna excelsa*, a tree some fifty or sixty feet high, growing in Jamaica and St. Vincent, and known in the West Indies as the "bitter wood" or "bitter ash." In addition to the chips and shavings, quassia is met with in the form of logs and billets, which are often as thick as the thigh. The wood is of a light yellow colour internally, and is greyish brown externally. The chips possess the same characteristics. The wood is dense and tough, is without odour, and has an intensely bitter taste. The "bitter cups" sold by chemists in country districts are turned out of logs of quassia wood. The first account of Jamaica quassia was given by Dr. John Lindsay, of that island, in 1791. He speaks of the tree as being well known, not only on account of its excellent timber, but as "a remedy for putrid fevers and fluxes." He adds that the bark is exported to England in large quantities, "for the purposes of brewers of ale and porter."

By calumba we mean the root, cut transversely and dried, of *Jateorrhiza calumba* (*Cocculus palmatus*), growing

in the forests of Eastern Africa between Ibo and Zambesi. The pieces are ovoid cylindrical discs, varying in diameter from one to three inches, and in thickness from an eighth to half an inch. The central portion is yellow and spongy, and on examination will be seen to be arranged in concentric layers. The outer portion has a dark green or olive colour. The slices become concavo-convex on drying, and are usually thinner in the centre. They are frequently worm-eaten, presenting a number of minute holes or apertures. Calumba root has very little odour, but an intensely bitter taste. It is held in high esteem by the natives of Eastern Africa, who call it *kalumb*, and use it in the treatment of dysentery, and in fact almost every disease.

By gentian we mean the dried root of *Gentiana lutea*, the yellow gentian which grows abundantly in Switzerland and on the Pyrenees. It is in long cylindrical pieces from half an inch to an inch in diameter, wrinkled and longitudinally twisted. It is brown externally, yellow and spongy within. The name gentian is supposed to be derived from Gentianus, King of the Illyrians, who flourished B.C. 180–167.

2. Active Principles.

Quassia contains:—

1. *Quassiin*, a bitter neutral principle. It is not an alkaloid.

The wood contains no tannin.

Calumba contains:—

1. *Calumbin*, a neutral principle.
2. *Berberine*, a yellow alkaloid, which gives it its colour. This berberine, or berberia, was first discovered in the common barbery, hence its name, and has since been found not only in calumba, but in various other medicinal

substances, especially those combining a bitter taste with a yellow colour, such as hydrastis, coptis, and podophyllum. It has nothing to do with sulphate of beberine, the tonic and antiperiodic obtained from bebeeru bark.

3. *Calumbic acid*, which probably exists in the form of calumbate of berberin.

Calumba contains much starch, but no tannin.

Gentian contains:—

1. *Gentio-picrin*, which gives it its bitter taste.
2. *Gentianin*, which is tasteless.

3. Preparations.

The preparations of quassia are (1) extract; (2) infusion; and (3) tincture.

The preparations of calumba are (1) extract; (2) infusion; and (3) tincture.

The preparations of gentian are (1) extract; (2) compound infusion; and (3) compound tincture.

A compound infusion or tincture is one which contains more than one active ingredient.

Most infusions are made with boiling water. The infusions of calumba and quassia are made with cold water, and the infusions of chiretta and cusparia with water at 120° F. The infusion of calumba is made with cold water, because calumba contains starch, which readily dissolves in boiling water but not in cold, and infusions containing starch do not keep well. If the infusion of calumba strikes a blue colour with iodine, it shows that it contains starch and has been made with hot water. The infusion of quassia is made with cold water, but not for the same reason, for it contains no starch. The real reason is that the active principle of quassia—quassiin—dissolves as readily in cold water as it does in hot.

It will be remembered that decoctions are prepared by boiling; infusions never.

As infusions of quassia and calumba contain no tannin, they may be given with preparations of iron without forming a black and unsightly mixture. The bitters which may be given with iron are:—

Quassia.
Calumba.
Cannella.
Chamomile (weak infusions).

4. Physiological Action.

All three drugs are stomachic bitters. It is usually said that bitters increase the secretion of digestive juices, and by their antiseptic action prevent decomposition and flatulence. This, however, is denied, and it is maintained by some that bitters check the secretion of the gastric and pancreatic juices, and even promote fermentation and putrefaction. It is probable that many of the bitters act as cholagogues, increasing the flow of bile.

Pure bitters differ from spices, such as coriander, cardamoms, carraway, anise, ginger, and the like, by exciting no general stimulation of the mucous membrane of the stomach. Schmiedeberg, speaking of the group of the simple bitters, says that their bitter taste is the only pharmacological test for them. He adds, "One may indeed accept it as true that these substances exert a special influence on certain nervous elements which are in the walls of the stomach, and are concerned in the process of nutrition, an influence similar to that which they exert on the nerves of taste. Nevertheless at present there is not a single genuine (experimental) proof to justify such a belief."

It is probable that as stomachic tonics there is little to

choose between quassia, calumba, and gentian, although calumba has the reputation of exercising what is called a "soothing effect" on the mucous membrane, and is supposed to be especially indicated in convalescence from acute illnesses. Many writers maintain that calumba is "more easily tolerated" by the stomach than the other bitters. Wood says that quassia is "probably the most active of all the bitter tonics." Schmiedeberg, on the other hand, says, "No one of these tonics has any special advantage as compared with the rest. Some physicians will prefer one, and others will prefer another." Possibly the presence or absence of tannin will influence the selection.

Quassia, in addition to its action as a bitter tonic, is very fatal to all the lower forms of animal life. On insects it exerts a narcotic influence, and the infusion sweetened with sugar or treacle is often employed to destroy flies. It is also used as an injection into the rectum to destroy thread-worms.

Quassiin in frogs produces great weakness, with convulsions or convulsive tremblings, failure of respiration, and finally arrest of the heart's action.

Calumbin slightly raises blood pressure, and in large doses lowers it.

Berberine, administered hypodermically to rabbits, produces a fall of temperature, accompanied by signs of prostration, but given by mouth it has little or no action. Fifteen grains, administered to a man, induced colicky pains and diarrhœa.

The drugs most closely allied in general action to quassia, calumba, and gentian, are chiretta (*Ophelia chirata*), cusparia (*Galipea cusparii*), and cascarilla (*Croton eluteria*).

PHYSOSTIGMA.

1. Introduction.

Physostigma, or Calabar bean, is the seed of the *Physostigma venenosum*, the "Ordeal Bean" of Western Africa. It is used by the natives of Calabar as a judicial test. The accused, who, in the absence of more definite evidence, is usually indicted for sorcery, is conducted to the temple of justice, where, in the presence of the spectators, he is invited to partake of the beans. The belief is that if they are rejected by vomiting the person is innocent, but if they are retained and prove fatal he is guilty. Under the circumstances an appeal is not possible. The result probably depends on the number of beans eaten. If the accused is innocent he partakes freely and without hesitation, and is sick; but if he entertains any doubt on the subject he indulges moderately, and, vomiting not being produced, he falls a victim to his over-conscientiousness. In savage duels the challenger bites a bean in two, swallows his morsel, and politely hands the other half to his opponent, who follows his example. The combatants are killed, and the result is satisfactory to everybody.

Physostigma was first raised from seed in 1860, in the Botanical Gardens in Edinburgh, and was named by Professor Balfour.

2. Alkaloids.

The alkaloids contained in physostigma are:—

1. *Physostigmine*, or *eserine*, met with in colourless crystals. It forms salts, of which the best known are the hydrobromate, the salicylate, and the sulphate. It represents the activity of the plant.

2. *Calabarine*, antagonistic to physostigmine and allied to strychnine. Possibly it is a derivative of physostigmine.

3. Preparations.

There are two official preparations, one of physostigma and one of physostigmine. They are:—

1. Extractum physostigmatis, or extract of Calabar bean.
2. Lamellæ physostigminæ, or discs of physostigmine, containing $\frac{1}{1000}$ of a grain in each.

4. Pharmacological Action.

One of the first experiments on physostigma was made by the late Sir Robert Christison on himself. On taking six grains of the seed he felt no effect, with the exception of a little numbness in the legs, but on increasing the dose to twelve grains he experienced a sensation of giddiness and drowsiness. An emetic was given, but, although it acted freely, the giddiness increased and was accompanied by extreme faintness and great prostration. The heart was feeble and irregular, but there was neither pain, numbness, nor pricking. After the administration of stimulants Sir Robert was able to move about a little, and as he felt sleepy he was allowed to doze for a couple of hours. The sleep he describes as "conscious sleep," so that on awaking he did not know that he had been to sleep at all. The next day he had completely recovered and felt quite well. He did not repeat the experiment.

Some years ago fifty children were poisoned at Liverpool from eating the beans. The sweepings of a ship from the West Coast of Africa were thrown on a rubbish heap, and a number of beans were found by the children and eaten by them. A boy, aged six, ate six beans, and died in a very short time. The symptoms were severe griping pains,

persistent vomiting, and contracted pupils. On attempting to walk, the children staggered as if drunk.

For an accurate knowledge of the action of physostigma we are indebted chiefly to the observations of Prof. T. R. Fraser, of Edinburgh.

Physostigma gives rise to paralysis, the posterior column of the cord being affected before the anterior.

The medulla is also paralyzed, and the respiratory movements cease before the reflex action of the spinal cord is destroyed.

The motor nerves are not affected till late, and the sensory nerves not at all, unless the drug is applied topically.

The brain is not paralyzed, and may even be stimulated, for when physostigma is given to epileptic subjects, the frequency of the fits is increased. Physostigma does not affect the centres of conscious impressions, and consciousness is preserved until the oxygenation of the blood is so far interfered with that carbonic acid narcosis supervenes.

Sometimes tetanus is observed, the symptoms being similar to those of strychnine poisoning. This is due to the action of the calabarine.

Physostigma, applied locally to the eye, causes contraction of the pupil, diminishes intra-ocular tension, and produces spasm of accommodation. Physostigma produces contraction of the pupil by its action on a local mechanism situated either in the iris or in the choroid. It produces tetanic contraction of the ciliary muscle, in the same way that it affects the sphincter pupillæ. The movements of the iris are always accompanied by variations of the intra-ocular pressure, dilatation of the pupil increasing it, and contraction of the pupil diminishing it. According to Hocker, physostigmine first increases intra-ocular pressure, and then diminishes it.

Physostigma acts as a stimulant to the muscle of the heart, and arrests it in systole. It may at first quicken respiration, but it ultimately retards it, and death is always due to failure of respiration. All parts of the central nervous system are paralyzed by physostigma, and death takes place from stoppage of respiration, with symptoms of acute suffocation.

Physostigma exerts a marked action on involuntary muscular tissue. It stimulates the muscular tissue of the stomach, and gives rise to retching and vomiting. It increases the peristaltic movements of the intestines, and may cause spasm and diarrhœa. It also contracts the spleen, the bladder, and, it is said, the uterus.

Physostigma acts as a stimulant to most of the secretions —the saliva, sweat, lachrymal, and mucous. The increased secretion is due, not to an action on the terminations of the secreting nerves, but to an influence on the cells themselves.

5. Synergists and Antagonists.

Physostigma, in its action on the cord, is allied to gelsemium. Physostigmine in this particular is antagonistic to strychnine and to picrotoxin, but calabarine is allied to both.

Physostigmine, in its action on the pupil and on the secretions, is allied to pilocarpine, and is antagonistic to atropine, hyoscyamine, and other members of that group. Atropine is the recognised antidote to physostigma. Fraser says: "The exhibition of the antidote should be persevered with in repeated doses until the pupils are fully dilated and the pulse rate increased, and probably also until the hypersecretion of bronchial mucous, which freely impedes respiration, is checked."

Physostigma, in its action on the secretions, is allied to muscarine.

An antagonism is believed to exist between chloral and physostigma. Chloral paralyzes the cord, physostigma stimulates it.

6. Therapeutics.

Physostigma is useful in tetanus. It must be given in large doses, from two to four grains of the extract hourly. It wants pushing, but its effect must be carefully watched.

In small doses it is useful in many nervous affections, such as locomotor ataxy, writers' cramp, and paraplegia due to myelitis. One-tenth of a grain of the extract, in the form of a pill, should be given every three hours, and the treatment should be kept up for six months, or longer. The improvement is slow, but the results are, on the whole, very satisfactory.

CAFFEINE.

1. Origin.

Caffeine is an alkaloid usually prepared from tea leaves (*Camellia thea*) or coffee berries, the dried seeds of *Coffea arabica*, by first making an infusion, then removing the astringent and colouring matter, and finally evaporating. It is also contained in guarana (the fruit and leaves of *Paullinia sorbilis*), in Maté or Paraguay tea (the leaves of the *Ilex Paraguaiensis*) and in the Kola nut (*Kola acuminata*). It will be remembered that Maté is largely employed in South America as a substitute for tea, and that similar properties are usually ascribed to guarana and the Kola nut. Caffeine may also be prepared synthetically from theobromine, an organic base existing in cocoa beans, and is then usually known as methyl-theobromine. Most of the caffeine of commerce is obtained from tea leaves.

Caffeine is chemically tri-methyl-xanthine, whilst theobromine is di-methyl-xanthine.

It is generally supposed that caffeine, theine, and guaranine are identical, and these names are recognized officially as synonyms for caffeine. Some doubt, however, exists on this subject, and Dr. Thomas J. Mays asserts that caffeine and theine are not physiologically identical, and that guaranine is a kind of halfway product between the two. Mays maintains that theine does not cause muscular rigidity, even when a muscle is immersed in a solution, but that caffeine uniformly induces this condition. Brunton and Cash fail to confirm this observation, but point out that there may be differences in the nature and, consequently, of the physiological action of the active principle obtained from different kinds of tea, or even of the same tea by different methods of extraction. Tea and coffee undoubtedly differ in their general effect on man, but very little weight can be attached to this fact, for coffee contains an empyreamatic oil which is developed in the process of roasting, and is not found in tea.

It is a noteworthy fact that most civilized nations, in addition to partaking of alcoholic beverages, resort to certain drinks which, although non-alcoholic, contain the same active principle in common. The Chinese have cultivated and drunk tea for over a thousand years. They usually take it without the addition of milk or any other substance. The Russians, as is well known, usually take it with a slice of lemon which develops the flavour, whilst the Germans often add a dash of cinnamon or vanilla. In England, tea is, as a rule, allowed to stand too long, and the tea of the poorer classes is little more than a decoction of tannin, which is a fruitful source of dyspepsia, and all kinds of gastric disorders.

Coffee, to be of any good, should be freshly ground, and

above all freshly roasted. When properly made it is a powerful stimulant to the nervous system. It produces an exaltation of the intellectual faculties, and a clearness of understanding which is distinctly pleasurable. The habit of using these nervine stimulants, when once established, is as difficult to break through as the custom of smoking, or of indulging to excess in alcohol. At the same time it must be confessed that the benefit derived from their use is distinctly greater than the harm they do. The effects of coffee and tea are not identical, for coffee, in addition to its empyreamatic oil, contains more gum and sugar, and very much less tannin than tea.

2. Physical and Chemical Characters.

Caffeine is an alkaloid capable of forming salts. It is usually in the form of light colourless acicular inodorous crystals, looking somewhat like fine white silk. It is soluble in one hundred parts of cold water, and freely in boiling water. It is a very feeble base, and the salts split up on the slightest provocation. The only official salt is the citrate, but the hydrobromate and many others are easily prepared.

Citrate of caffeine, caffeinæ citras, is a weak combination of caffeine and citric acid, and is usually regarded as a doubtful salt. It is sometimes seen in white needle-like crystals or masses of crystals, but is more frequently amorphous. A popular preparation is the effervescing citrate of caffeine. The physiological action of the citrate is identical with that of caffeine itself.

3. Physiological Action.

(1) *On the lower animals.*—In frogs the chief symptoms induced by caffeine are muscular weakness succeeded by violent tetanic convulsions, general paralysis, and death by

asphyxia, the heart continuing to contract after the cessation of respiration, although evidently much affected. The convulsions are purely muscular in origin, and are allied to *post-mortem* rigidity. When an isolated muscle is soaked in curare so as to paralyze the motor nerves, and is then treated with a solution of caffeine, the usual rigidity is developed. When under the microscope a muscle fibre is touched with caffeine, it is seen to contract to half its length. It is asserted that the action on frogs varies according to the species employed. In *Rana temporaria* it produces a rigid condition of the muscles resembling rigor mortis, especially when locally applied; but in *Rana esculenta* the action on the muscles is slight, and the chief symptom induced is tetanus, which, like that of strychnine, is spinal in origin.

In birds the symptoms produced by caffeine are irregular movements, due apparently to cerebral disturbance, increased rapidity and irregularity of respiration, spasmodic tremblings and clonic convulsions.

In mammals the symptoms are restlessness, hurried respiration, first a lowering and then a decided elevation of temperature, muscular weakness, tetanic and clonic convulsions, and finally death from arrest of respiration. In cats it produces a condition of almost frantic cerebral excitement.

(2) *On man.*—In man caffeine acts as a stimulant to the higher centres. It produces heaviness of the head, flashes of light before the eyes, singing in the ears, loss of sleep, restlessness, and in large doses delirium. It is said that under its influence the sight becomes more acute, the hearing more sensitive, and the taste more refined. In some people it exerts a stimulating and refreshing effect, promoting muscular and mental activity, and a sense of cheerfulness. In others it gives rise to a condition of intense wakefulness, accompanied by a peculiar state which is best described by the term anxiety.

(3) *As a diuretic.*—It has long been known that the group of bodies called xanthines possess diuretic properties, and this action is well marked in the case of caffeine. Brakenridge was of opinion that this action was due to stimulation of the renal glandular epithelium. Dr. C. D. F. Phillips, working in conjunction with Dr. Bradford, has shown, by experiments with the oncometer, that citrate of caffeine exerts a powerful action, both on the kidneys and on the blood-pressure. Immediately after the injection of the drug the kidney contracts, and this contraction may last for two or three minutes, whereas the fall of the general blood-pressure lasts only twenty or thirty seconds. The marked contraction of the kidney, which is of course due to a constriction of the renal vessels, is followed by a large expansion, which is not only much greater in amount than the previous contraction, but lasts a longer time. During the period of contraction, the flow of urine is either greatly diminished, or may even be totally arrested. During the subsequent expansion the rate of flow is frequently trebled, and this effect persists as long as the expansion. The effect of caffein citrate is a two-fold one. During the first stage of its action there is a fall of general blood-pressure, and constriction of the renal vessels; during the second stage the blood-pressure returns to its normal height, and the kidney undergoes great expansion. The last stage persists much longer than the first.

The objections to the use of caffeine as a diuretic are many. It sometimes acts as a purgative as well as a diuretic. Then again, although at first it produces copious diuresis, tolerance is soon established and it loses its diuretic power. Moreover it is a powerful cardiac stimulant, and in many people exerts a very marked excitant action on the central nervous system. Lastly, and as a minor disqualification, it sometimes sets up considerable smarting in the penis, and produces a mild form of urethritis.

(4) *On tissue metamorphosis.*—There is reason to suppose that caffeine checks organic combustion and tissue waste, although the evidence as to its influence on the elimination of urea is not conclusive.

(5) *As an anæsthetic.*—Caffeine probably acts as a local anæsthetic, in much the same way as does cocaine.

4. Allies and Uses.

The dose of caffeine is from one to five grains, and of the citrate from two to ten grains. Many patients experience much difficulty in taking the larger doses.

Tea and coffee in general action are allied to Maté or Paraguay tea and to coca or guarana.

A slight modification in the chemical composition of caffeine materially alters its physiological action. In many cases caffeine (trimethylxanthine) whilst acting admirably as a diuretic, over-stimulates the nervous system and produces sleeplessness. Theobromine (dimethylxanthine), whilst acting equally well on the kidneys, has none of these disadvantages. It is said to be five times as active a diuretic as caffeine, but the objection to its use is that it is insoluble in water. A substance has been obtained, containing from forty-four to forty-eight per cent. of theobromine in combination with hydrate and salicylate of sodium, and to this body the name "diuretin" has been given. It is said to have no action on the heart, but to be capable of inducing a copious flow of urine so long as there is any healthy or comparatively healthy tissue for it to act on.

The chief clinical use of citrate of caffeine, apart from its action as a diuretic, is in the treatment of headache and megrim. Care must be taken to distinguish between the official citrate of caffeine and the popular "effervescing citrate of caffeine," which contains a grain in the drachm. Serious symptoms have resulted from telling a patient to

take "a drachm of citrate of caffeine" when the effervescing salt was intended. The dose of effervescing citrate of caffeine is a drachm or more, whilst the dose of the official salt is from one to five grains.

CONIUM.

1. Origin.

By conium we mean the fruit, fresh leaves, and young branches of *Conium maculatum*, the common greater or spotted hemlock, an indigenous plant growing wild in almost every climate, and found in abundance in hedgerows and waste places. The root is fusiform, like the parsnip; the stem is from two to five feet high, herbaceous, erect, round, hollow, much branched, polished and variegated with spots and streaks of a reddish-brown colour. The leaves resemble those of the common parsley.

The word conium is derived from κωνος, a cone or top, and is probably used figuratively in reference to the giddiness which preparations of the plant induce when taken internally.

The official parts are the fruit and the fresh leaves and young branches. The root is the least active portion, and when gathered at certain seasons of the year is almost inert. Both the leaves and the fruit have a strong, heavy odour, which is developed by the action of an alkali, and resembles the smell of mice or the urine of cats.

2. Active Principles.

(1) *Coniine, Conine, or Conia.*—This is a liquid alkaloid, colourless when pure, and having a powerful odour of mice. This odour is characteristic, and may be detected in a solution containing not more than one fifty-thousandth part of the alkaloid. Coniine is soluble in ether and in alcohol,

and is slightly soluble in water. It leaves a greasy stain on paper, which disappears on warming. It forms salts with acids, which are odourless, but on neutralizing the acid with an alkali the smell at once becomes apparent. The vapour of the alkaloid is inflammable and burns with a yellow flame, giving off a great deal of smoke.

(2) *Methyl-coniine or Methyl-conia.*—This alkaloid exists in conium in variable quantities, and is often a large ingredient in commercial coniine. Possibly it is a decomposition product. Coniine is represented by the formula $C_8H_{15}N$, whilst methyl-conine is $C_9H_{17}N$.

(3) *Conhydrin or Condrin.*—This is a solid alkaloid, and is much less active than coniine.

(4) *Conic Acid* is also present, but presents no points of interest.

A volatile oil is also found, which is not poisonous.

3. Preparations.

I. *Of the leaves.*

1. Succus Conii.—Hemlock juice. The expressed juice of the fresh leaves, with the addition of one-third of rectified spirit. From the juice is made the ointment.

2. Extractum Conii.—Extract of hemlock. This extract is prepared in the same way as other green extracts.

3. Pilula Conii Composita.—Compound pill of hemlock contains extract of hemlock and ipecacuanha.

4. Cataplasma Conii.—Hemlock poultice. Made by mixing together hemlock leaves and linseed meal.

5. Vapor Coniæ.—Inhalation of coniine. An inhalation not of conium, but of coniine, prepared by adding solution of potash to the extract.

II. *Of the fruit.*

1. Tinctura Conii.—Tincture of hemlock. A tincture made with proof spirit.

4. Physiological Action.

Conium is a most active poison, being, according to some, only second in activity to hydrocyanic acid. The effects are due to the coniine and methyl-coniine it contains. These active principles being volatile and liable to decomposition, the activity of different preparations of the plant is in the highest degree uncertain. Probably the succus is the most reliable. The quantitative relation of the two alkaloids varies much. Their actions are similar, though not identical, methyl-coniine exerting a special influence on the spinal cord, and causing paralysis of reflex action.

The action of conium on man and on the lower animals is in the main the same, although some vegetable feeders, such as goats, sheep, and horses, eat the leaves with impunity.

A good idea of the general action of conium may be gathered from the account of the death of Socrates, as given by his friend and disciple, Plato. Christison, it is true, maintained that the plant actually employed was not conium, but a closely allied species; but the description is sufficiently accurate for all practical purposes:—

"And Crito, hearing this, gave the sign to the boy who stood near. And the boy departing, after some time returned, bringing with him the man who was to administer the poison, who brought it ready bruised in a cup. And Socrates, beholding the man, said, 'Good friend, come hither; you are experienced in these affairs, what is to be done?' 'Nothing,' replied the man, 'only when you have drunk the poison, you are to walk about until a heaviness takes place in your legs; then lie down; this is all you have to do.' At the same time he presented him the cup. Socrates received it from him with great calmness, without fear or change of countenance, and regarding the man with his

usual stern aspect, he asked, 'What say you of this potion? Is it lawful to sprinkle any portion of it on the earth as a libation or not?' 'We only bruise,' said the man, 'as much as is barely sufficient for the purpose.' 'I understand you,' said Socrates, 'but it is certainly lawful and proper to pray the gods that my departure from hence may be prosperous and happy, which I indeed beseech them to grant.' So saying, he carried the cup to his mouth, and drank it off with great promptness and facility.

"Thus far most of us had been able to refrain from weeping; but when we saw that he was drinking, and actually had drunk the poison, we could no longer restrain our tears. And from me they broke forth with such violence that I covered my face and deplored my wretchedness. I did not weep for his fate so much as for the loss of a friend and benefactor, which I was about to sustain. But Crito, unable to restrain his tears, was compelled to rise. And Apollodorus, who had been incessantly weeping, now broke forth in loud lamentations, which affected all who were present except Socrates. But he, observing us, exclaimed, 'What is it you do, my excellent friends? I have sent away the women, that they might not betray such weakness. I have heard that it is our duty to die cheerfully, and with expressions of joy and praise. Be silent, therefore, and let your fortitude be seen!' At this address we blushed, and suppressed our tears. But Socrates, after walking about, now told us that his legs were beginning to grow heavy, and immediately lay down, for so he had been ordered. At the same time the man who had given him the poison examined his feet and legs, touching them at intervals. At length he pressed violently upon his foot, and asked if he felt it, to which Socrates replied that he did not. The man then pressed his legs, and so on, showing us he was becoming cold and stiff. And Socrates, feeling it himself,

assured us that when the effects had ascended to his heart he should then be gone. And now the middle of his body growing cold, he threw aside his clothes, and spoke for the last time, 'Crito, we owe the sacrifice of a cock to Æsculapius. Discharge this and neglect it not.' 'It shall be done,' said Crito; 'have you anything else to say?' He made no reply, but a moment after moved, and his eyes became fixed. And Crito, seeing this, closed his eyelids and mouth."

The chief action of the drug is on the motor nerves, and especially on the motor extremities of these nerves. It can be shown experimentally that it is not due to any action on the muscles themselves, for they contract to galvanic stimuli applied locally just as freely as muscles which have not been subjected to the action of the drug. The paralysis is not due to the action of the drug on the cord, for when one leg is protected by ligature of the artery and vein and the poison is injected, there is no paralysis in the protected limb, although the drug has full access to the cord. The reason for supposing that the drug acts chiefly on the peripheral extremity of the nerve is, that if the vessels are ligatured and the leg then cut off, leaving it attached only by the motor nerve, the paralysis ensues more quickly in the unsevered limb than in its fellow, although the main trunk of the nerve is in each case equally exposed to the action of the poison. We know that the sensory nerves are not paralyzed, for if one limb is protected from the action of the poison by ligature of the vessels, irritation of the paralyzed limb induces movements in the leg which is not protected. The brain is clearly not affected, or at all events only in a secondary degree, for sensibility—the case of Socrates to wit—remains unaffected to the last. Death ensues from paralysis of the respiratory muscles.

The pupils in cases of poisoning by conium are dilated,

and there is usually ptosis, due to paralysis of the third nerve. The dilatation of the pupil is also the result of paralysis of this nerve, and is not due to stimulation of the sympathetic. The involuntary muscles are not affected, for peristaltic movements of the intestines are observed *post mortem*. There is no direct effect on the heart, for although it soon ceases beating in cases of poisoning by this drug, its action can be maintained by keeping up artificial respiration.

Coniine is a very active poisonous alkaloid, which produces marked paralytic and less obvious spasmodic principles. The former symptom depends principally on an action on the peripheral terminations of the motor nerves, but the causation of the latter is not known. Coniine does not directly influence the functions of the sensory nerves, striped muscles or heart. Considerable differences are met with, both in the nature of the action and in the lethal activity of various samples of the drug.

5. THERAPEUTICS.

Large doses of conium are useful in acute mania, tetanus, and chorea. The succus should be given in doses of from one to four drachms three times a day. The dose may be rapidly increased, and even young children will, after a few days, take six drachms hourly without the production of untoward symptoms.

Conium is closely allied in physiological action to curare.

ASAFŒTIDA—AMMONIACUM—MYRRH—GUIACUM.

These drugs, with the exception of guiacum, belong to the class which, for the want of a better name, we call "anti-spasmodics." Schmiedeberg groups them together

under the head of "Ill-smelling substances which act as neurotics." He points out that many vegetable substances of disagreeable odour are employed with much success when there is a general increase of sensory and motor sensitiveness. As they contain no peculiar active principle, it is probable that their virtues are attributable to their odour, and that the action is reflex in character. Wood says: "In certain conditions of the nervous system—conditions associated with weakness rather than with simple depression—the nerve centres appear to be more susceptible than is normal to external impressions, as well as to those impulses which originate in the cerebral centres themselves and are connected with the emotions. As a result of this state, various symptoms arise of trifling import, but often apparently severe, and always annoying. Such symptoms in their mildest form constitute the state of unrest known as 'nervousness;' in their severer type they may rise in intensity up to the wildest convulsions of hysteria. It is in this class of affections that the so-called anti-spasmodics are useful. As the condition which they relieve is nearly always associated with weakness, they are often spoken of as 'nerve stimulants.' In regard to most of them there is but little evidence of their power or functional activity when administered to healthy individuals. Some of them act very slightly upon the circulation when given in very large doses, and a few when administered as freely as possible induce slight cerebral symptoms, such as vertigo. As any theory of the method in which the hysterical convulsion originates—of its immediate causes and the mechanism of its production—would, with our present knowledge, be at the best but an ingenious speculation, the safest plan in regard to the action of drugs belonging to the class now under consideration is to accept the teachings of clinical experience as to facts, and to avoid theorizing

as to the way in which the results are brought about." Other members of the group are musk, castor, valerian, and amber.

Asafœtida is a gum-resin exuding from the root of Ferula Narthex (*Narthex asafœtida*), a native of Persia, Afghanistan, and the Punjab.

Ammoniacum is a gum-resin exuding from the stem of Doremo ammoniacum, a native of Persia and the Punjab.

Myrrh is a gum-resin exuding from the stem of Balsamodendron myrrha, a native of Arabia and Abyssinia.

Guiacum Wood, or Guiac Wood, is the wood of Guiacum officinale, the lignum vitæ, a tree from thirty to forty feet high, a native of Jamaica. On making an incision and the application of heat the wood yields:—

Guiacum resin, a dark brown transparent brittle aromatic substance.

In connection with this subject it is necessary to explain the meaning of one or two terms in common use:—

Resins are brittle amorphous solids, exudations from trees. They are characterized by being insoluble in water, soluble in spirit, and by softening or melting when heated, and solidifying again on cooling. They are oxidized terpenes, and consist of an acid or mixture of acids. They dissolve in alkalies, forming a kind of soap. They may be obtained from oleo-resins, such as turpentine, by simple distillation, the volatile oil passing over, and the resin remaining behind; or they may be obtained, as in the case of guiacum resin, simply by heating the part of the plant in which they are contained. The best examples of resins are the resins of jalap, podophyllum, scammony, and guiacum.

Gum-resins are natural mixtures of gum and resin. When rubbed up with water the gummy matter dissolves, and the resin is suspended so as to form an emulsion.

The best examples of gum-resins are asafœtida, ammoniacum, myrrh, and galbanum.

The members of this group are allied in composition :—

Asafœtida is composed of resin sixty-five per cent., gum twenty-five per cent., and about four per cent. of a volatile oil, with saline matters. The volatile oil contains sulphur.

Ammoniacum is composed of resin seventy per cent., gum twenty per cent., and a volatile oil four per cent., with saline matters. The oil does not contain sulphur.

Myrrh is composed of resin forty-four per cent., gum or arabin forty per cent., volatile oil four per cent., with more or less water and salts. The resin is known as myrrhin, a substance which, by keeping, becomes converted into myrrhic acid.

Guiacum resin contains no gum, and is composed chiefly of resinous acids.

The preparations of asafœtida are an enema, a pill of aloes and asafœtida, a compound asafœtida pill, a tincture, and the fetid spirit of ammonia.

The preparations of ammoniacum are a mixture, and the plaster with mercury.

The preparations of myrrh are a tincture, and the pill of aloes and myrrh.

The preparations of guiacum resin are the mixture, and the ammoniated tincture. Guiacum resin also enters into the composition of the compound calomel pill, whilst guiacum wood is one of the constituents of the compound decoction of sarsaparilla.

Guiacum is probably the active ingredient in the "Chelsea Pensioner," which for many years has held a high reputation amongst old soldiers for the relief of rheumatism. There are two formulæ for the preparation.

CHELSEA PENSIONER.

Powdered guaiacum	... ...	1 oz.
Powdered rhubarb...	... ...	2 drs.
Bitartrate of potash	... ...	1 dr.
Sublimed sulphur ...	... ...	1 dr.
Powdered nutmeg ...	... ...	$\frac{1}{2}$ dr.
Honey	... ...	1 lb.

To be mixed thoroughly. Two large table-spoonfuls to be taken night and morning.

The other formula is:—

Powdered guaiacum	... ...	$1\frac{1}{2}$ drs.
Mustard powder ...	... ...	3 drs.
Sublimed sulphur	... ...	3 drs.
Powdered rhubarb	... ...	45 grs.
Nitrate of potash...	... ...	45 grs.

Mix thoroughly. A tea-spoonful of the powder may be taken in milk at bedtime, or sufficient honey, treacle, or glycerine may be added to form an electuary, and of this a tea-spoonful may be taken.

These drugs, especially the first three, have a somewhat similar action, but asafœtida, probably from the fact that its oil contains sulphur, is much the most powerful. They are all stimulants, and induce a condition of general exhilaration often accompanied by headache and giddiness. They are antispasmodics, and stimulate the walls of the stomach and intestines, expelling flatus. They also increase the secretion of the mucous membrane of the intestines and are mild purgatives, the motions being offensive in odour. In large doses they excite nausea and vomiting, and also act as expectorants.

Myrrh is largely used as a local astringent for the mouth and gums. It is also useful as an emmenagogue, but is inferior in this respect to permanganate of potassium.

Guaiacum has a special and distinctive action, and is now

largely employed as a laxative or purgative. In most of the text-books on materia medica we are told that guaiacum resin acts as "a stimulant, diaphoretic, and diuretic." I cannot find that there is much evidence in support of this view. Wood seems to be of the same opinion, for he says: "Guaiacum is believed by some to act as a diaphoretic, and to do good by increasing the elimination of the skin; but as I have not been able to obtain, either from medical literature or from the exhibition of the medicine, any distinctive proof of its having any such action to any marked extent, I have preferred to consider the drug as an alterative." Schmiedeberg curiously enough deals with it under the head of "Drugs and preparations used for all sorts of purposes, but now mostly antiquated and obsolete." I am inclined to think that its main action is as a laxative or purgative, and this view is evidently shared by Phillips, who, in his well-known work on the "Vegetable Kingdom," states that in large doses it produces "dryness in the mouth, burning in the throat, a sensation of heat in the stomach, loss of appetite, heartburn, flatulence, nausea, vomiting, and purging."

My attention was drawn to the subject some years ago by casually prescribing for a city man suffering from rheumatism some guaiacum lozenges made up with black currant paste. He continued taking them long after the pains had ceased, and his explanation was that they did him good by acting on the liver and bowels. He said that one or two of the lozenges taken in the morning before breakfast acted promptly and without inconvenience. I ordered the lozenges for other of my patients suffering from constipation, and what is conveniently called "biliousness," and the result was equally satisfactory. The lozenges not being available for hospital use, I had a confection prepared containing ten grains of

guaic resin to a drachm of honey. This was curiously popular with the patients, and for the last two years I have used it extensively, not only as a purgative, but in the treatment of chronic rheumatism, sciatica, tonsilitis, litis, dysmenorrhœa, and allied affections. The confection is nasty, but is appreciated by patients. At first I gave it in drachm doses once a day, but they were not satisfied with this, and I had to increase the dose to two drachms three times a day. In this quantity it seems capable of producing the maximum of inconvenience and discomfort, and gives unlimited satisfaction. The purgative effect is very pronounced, and in one case the patient had fifty-six evacuations in the week. In another case it produced a well-marked rash, covering the arms and legs with an eruption which forcibly reminded one of copaiba. That this rash is rare may be gathered from the fact that my colleague, Dr. C. T. Fox, had seen only one similar instance. It was accompanied by intense itching, which disappeared on discontinuing the drug. The guaiacum not infrequently gives rise to a burning sensation in the throat, and to obviate this I prescribed the ten grains of the resin in half an ounce of extract of malt, which answered admirably. This method of treatment is, perhaps, simply a return to the old-fashioned "Chelsea Pensioner," but it is interesting nevertheless. I am sure that a trial of the guaiacum resin as a laxative or purgative according to the dose employed will be found satisfactory. It is probable that if the drug were triturated with cream of tartar, sugar of milk, or some other equally inert substance its efficacy would be increased, and it would produce the desired effect in smaller doses.

By the destructive distillation of guaiacum we get guiacol, a substance contained in beech creasote to the extent of from sixty to ninety per cent. It is a methyl ether of pyrocatechin, and when pure is a colourless fluid, only slightly soluble in

water, but soluble in alcohol, ether, glycerine, fats and oils. Its taste and odour resemble those of creasote, but it is more agreeable to take. Of late years it has been largely employed in the treatment of phthisis, and is said to exert a curative influence on the tubercular lesions in the lungs by promoting sclerotic changes. It diminishes the expectoration, lessens its purulency, and removes its fœtid odour. The following formula may be used:—

Guiacol	1 dr.
Compound tincture of gentian	2 drs.
Tincture of orange	2 drs.
Brandy	2 ozs.
Malaga	to 10 ozs.

Two tea-spoonfuls to be given in a tumblerful of cold water, three times a day, after meals. The dose may be gradually increased.

Another mode of administration, is to dissolve it in glycerine and then mix it with rum. Good results have been obtained by saturating the system with the drug, and with this view it is often given hypodermically. Burney Yeo speaks highly of capsules containing one and a half minims of guiacol, a quarter of a grain of iodoform, and three minims of cod-liver oil, one or two being given twice or three times a day after meals.

Foxwell's observations would indicate the desirability of increasing the dose of iodoform.

The vapour of guiacol might be used with advantage for impregnating the air of the room in which the patient lives or sleeps. The following formula is suggested:—

Guiacol	1 dr.
Menthol	½ dr.
Thymol	½ dr.
Camphor	½ dr.
Oil of cannella	10 drops
Rectified spirit	to 6 ozs.

A tea-spoonful should be placed in a small metal vessel filled with water and allowed to evaporate slowly over a spirit lamp.

The carbonate of guiacol in doses of fifteen grains is frequently prescribed, both in phthisis and in enteric fever. It is a white powder, insoluble in water, but soluble in spirit. It may be conveniently given in port wine, and in daily doses of forty-five grains. I have seen good effects from it in advanced phthisis.

The Benzoate of guiacol, under the name of Benzosol, is recommended as a substitute for creasote, and is commonly given in five-grain doses.

Oil of amber, which is closely allied to the other members of this group, is an excellent remedy for uncomplicated whooping-cough. It may be given internally, and also rubbed freely on the back and chest.

CINCHONA AND ITS ALKALOIDS.

1. History.

The precise period and manner of the discovery of the therapeutical properties of cinchona bark are enveloped in obscurity. Some think that the Indians knew all about it before the arrival of the Spanish, whilst others affirm that the Spaniards investigated the matter and told the natives.

The bark was brought to Spain in 1632, but was not employed medicinally until 1639. It is usually stated that we are indebted to the Countess of Cinchon for the introduction of the drug, which was originally known as "Cinchona Bark," or "The Countess's Powder." The lady in question was the wife of Count Cinchon Don Geronino Fernandez de Cabrera Bobadella J. Mendoza. Some ten years later it was carried by the Jesuits to Rome, one of the

most active members of the order in promoting its distribution and use being Cardinal de Lugo. From this circumstance it acquired the names of "Jesuit's Bark," and "Pulvis Cardinal de Lugo." In course of time it fell into disuse, but was again brought into vogue by the physician to Charles II., Sir Robert Talbor, who acquired a great reputation for the cure of ague by a secret remedy. The secret was purchased for a large sum on Talbor's death by Louis XIV., and turned out to be the cinchona bark.

2. Origin.

The different species of cinchona are natives of the Andes, growing chiefly on the eastern face of the Cordilleras, from four thousand to twelve thousand feet above the sea level. The cinchonas themselves seldom form an entire forest, but either grow separately or are collected in clumps. The men who collect the bark and are otherwise engaged in the trade are known as *cascarilleros*, or "bark peelers." The word *cascarilla* is the diminutive of *cascara*, and signifies literally "small bark." The term Cascara Sagrada, or sacred bark, is familiar to us. Much practice is required on the part of the cascarillero to detect the presence of the cinchona trees in the dense forests, which are made up of vast collections of palms, tree ferns, gigantic climbers, bamboos, plantains and other plants. Originally the tree was felled, and after the branches had been cut off the bark was removed from the trunk by making incisions and striking it with a mallet. The method was wasteful, and rapidly thinned the forests of the cinchona trees, so that the supply fell short.

Two kinds of cinchona bark are now official—cinchona bark (*Cinchonæ cortex*) and red cinchona bark (*Cinchonæ rubræ cortex*). By cinchona bark is meant the dried bark of cinchona calisaya, cinchona officinalis, cinchona succirubra, cinchona lancifolia, and other species of cinchona,

from which the peculiar and characteristic alkaloids of the bark can be extracted. It is also stated officially that salts of quinine and cinchonine may be obtained from some species of Remijia; in fact, the definition is a wide one. By red cinchona bark is understood the dried bark of the stem and branches of cultivated plants of cinchona succirubra. Cinchona has for many years been successfully cultivated in India, Java, Ceylon, and also Jamaica, and it is found that the cinchona succirubra is the hardiest and most readily propagated.

3. Active Principles.

The chief alkaloids contained in cinchona bark are quinine, cinchonine, quinidine, and cinchonidine.

There are four official salts of alkaloids obtained from cinchona bark. These are: (1) sulphate of quinine; (2) hydrochlorate of quinine; (3) sulphate of cinchonine, and (4) sulphate of cinchonidine.

Sulphate of Quinine is in the form of silky snow-white crystals, having an intensely bitter taste. It is soluble in water to the extent of one in seven or eight hundred, and is freely soluble in water acidulated with sulphuric acid. The addition of the sulphuric acid converts the sulphate into a bisulphate, which is much more soluble in water than the common sulphate. In America the bisulphate is almost universally employed. Solutions of quinine present an appearance which is known technically as "fluorescence," a peculiar sheen or shining appearance on the surface of the liquid which is readily recognized. This fluorescence is not confined to salts of quinine, and is presented by solutions of gelsemine, the alkaloid of *Gelseminum sempervirens*, or Carolina jasmine.

Hydrochlorate of Quinine resembles the sulphate in general appearance, but the crystals are somewhat larger. They

are more soluble in water, dissolving in the proportion of one in twenty-four.

Quinine itself is not in the Pharmacopœia, and it is only the above-named salts which are officially recognized. The terms quinine, quinia, and quinina are used synonymously.

Sulphate of Cinchonine is in the form of hard colourless prismatic crystals which have a vitreous appearance. It is soluble in water, but the solutions with acid are not fluorescent. Cinchona salts are cheap, but their nauseous taste is objectionable.

Sulphate of Cinchonidine is in colourless silky crystals, soluble in water.

The other alkaloids of cinchona are of comparatively little importance. The acids obtained from the bark are quinic acid and quino-tannic acid, the latter differing from common tannic acid only in a few unimportant chemical reactions.

4. Preparations.

All the preparations of cinchona are made from the red bark, the common or yellow bark being employed solely for the extraction of the alkaloids. The preparations of the red bark are five in number, the decoction, the liquid extract, the acid infusion, the tincture and the compound tincture. Red cinchona bark is also contained in the aromatic mixture of iron.

5. Pharmacology.

The action of cinchona is for all practical purposes that of the alkaloids it contains, and of these alkaloids quinine may be taken as the type. The pharmacological action of this alkaloid has been pretty fully worked out, and may be summed up very briefly:—

(1) It is fatal to the lowest forms of animal and vegetable life, a fact which explains its power of retarding, preventing, and arresting putrefaction.

(2) It checks fermentation, especially when it depends on organized ferments. It arrests alcoholic, lactic, and butyric fermentation. It is a powerful antiseptic, and even dilute solutions will preserve meat, milk, butter and other articles of food.

(3) It lessens protoplasmic and amœboid movements, and checks the migration of the white blood corpuscles from the vessels. It also causes contraction of the spleen.

(4) Small doses improve the appetite, but large doses check digestion, and not infrequently cause loss of appetite, and may even give rise to nausea and vomiting.

(5) Small doses increase the force of the circulation, but large doses weaken the heart's action, chiefly from an influence on the motor ganglia, and perhaps in a minor degree from an action on the muscular substance. Large doses diminish blood pressure, partly by paralyzing the action on the heart, and partly by paralyzing the vaso-motor centre.

(6) In small doses it acts as a stimulant to the nervous system. In large doses it diminishes reflex action by stimulating Setschenow's centre. The sensory and motor nerves are affected only when the drug is applied locally.

(7) It lowers the temperature and acts as an antiperiodic in malarial diseases. It induces this effect by checking oxidation. Moderate doses distinctly diminish tissue change, and lessens the amount of nitrogen and of sulphates in the blood.

(8) In the process of excretion it stimulates the genito-urinary tract, and may exceptionally produce irritability of the bladder and of the urethra.

It is probable that the other alkaloids of cinchona have much the same action, differing only in degree or intensity.

As regards antipyretic action, the alkaloids are pretty much on a par. They all possess febrifuge properties.

It is often said that quinine is an ecbolic, and is capable of producing abortion. I must have given it hundreds of times in fairly large doses to pregnant women suffering from neuralgia, and I have never known it exert any action on the uterus.

When quinine is given internally in large doses a series of symptoms is produced to which we apply the term "cinchonism," or "quinism." These doses affect the sight and hearing, excite subjective noises in the ears, as of bells ringing, and occasionally produce deafness, which may be permanent, but is usually temporary and lasts only a few days. Large doses often dim the sight and cause temporary blindness. Severe frontal headache, with dull, heavy, tensive or agonizing pain, may be experienced. The face is flushed, the eyes are suffused, and the expression is dull and stupid. These symptoms are due to the action of the drug on the brain. Sometimes quinine brings out a rash which may be followed by desquamation. Some people are peculiarly susceptible to the action of cinchona and its alkaloids.

Quinine diminishes the excretion of urea, uric acid, creatinine and of sulphuric and phosphoric acids. It is eliminated chiefly by the urine, and may usually be detected in from two to five hours after a large dose.

Quinine was at one time regarded as a drug of primary importance, but since the introduction of antipyrin and antifebrin it has lost much of its former popularity, and is now comparatively little employed.

6. Therapeutics.

Quinine is useful in ague. The rule is to give thirty grains between the termination of the first paroxysm and the time at which the second paroxysm is due. The best

plan is to give the first ten-grain dose about the end of the sweating stage, and to give the last ten-grain dose just before the next fit is due. It is not a matter of much importance in what form the quinine is given; some people take it as a powder, others like it in pills, whilst others again dissolve the dose in a small quantity of sherry. If it is not retained by the stomach, it had better be mixed with four ounces of beef-tea or gruel and injected into the rectum. Hypodermic injections of quinine are not very satisfactory, but a grain of the hydrobromate may be dissolved in six minims of water, of which the dose is from three to six minims.

Quinine is useful in some forms of neuralgia, the indications for its use being (1) that the pain is supraorbital, (2) that it is periodic, or (3) that there is a history of malarial disease. Five grains three times a day usually afford relief.

In all affections due to or associated with a malarial taint, it is a good plan to give quinine. Americans take very much larger doses than do English people.

In neuralgia of the face, especially when the branches of the fifth are involved, the addition of fifteen minims of tincture of gelsemium to each dose of the quinine mixture will be found an advantage. When the quinine is given in the form of a pill, a sixtieth of a grain of gelsemine hydrochlorate should be added.

SALICIN.

Salicin is a glucoside obtained from the bark of various species of willow and other plants.

It occurs in the form of white tabular, scaly, or acicular crystals, having no odour and a slightly bitter taste. It is soluble in cold water and in spirit. By warming it with sulphuric acid it is converted into glucose or saligenin.

It was but little used in medicine until 1874, when Dr. Maclagan introduced it as a remedy for acute rheumatism.

Its physiological action is similar to that of salicylic acid and salicylate of sodium.

It is rapidly absorbed from the stomach, but in the blood it speedily undergoes decomposition, saligenin, salicylic acid, and unchanged salicin appearing in the urine. The elimination takes place slowly, salicylic acid being detected in the urine sixty hours after a single dose of salicin has been taken.

In the lower animals in large doses it produces convulsions, fall of blood pressure, and, finally, stoppage of respiration, its action in this respect resembling carbolic acid.

In order to produce symptoms characteristic of the drug, it is necessary in the case of the human adult to give one large dose of a drachm or more, or to administer half a drachm hourly. Given less frequently or in smaller doses it induces little physiological effect. The condition of a person under full medicinal doses of the drug resembles that of a patient suffering from quinism. The expression is dull and apathetic, the face flushes on the slightest excitement, and the eyes become suffused. The patient is usually more or less deaf, and complains of singing noises in the ears. There is frontal headache, and the hands when held out are seen to be tremulous. The breathing is quickened and deepened. Some of these symptoms may be absent, but the dull heavy aspect and the dusky flush which quickly spreads uniformly over the face are always noticeable. With larger dose the headache is severe, so that the patient buries his head in the pillow and endeavours to avoid the light. There is marked muscular weakness accompanied by tremor, and a tap on the shoulder causes the muscles to contract so violently and suddenly as to jerk the arm backwards. Tingling in the extremities and

other parts of the body is a common subject of complaint. The voice is thick and husky, and the respiration is so hurried and deepened as to be almost panting.

Salicine, even in large doses, depresses the normal temperature very slightly if at all. The pulse is quickened, and usually becomes very weak.

Salicine renders the sweat neutral or alkaline, and this may occur in cases of acute rheumatism if the doses given are sufficiently large.

At one time salicin was largely employed therapeutically, not only in rheumatic fever but in chronic rheumatism, tonsilitis, neuralgia, and a number of other diseases.

If its action depends on its conversion into salicylic acid, it is clear that it can have no advantage over the latter substance. Dr. Maclagan, however, declines to accept Senator's views as to the conversion of salicin into salicylic acid. For a time the ill effects which so frequently followed the administration of the artificial salicylate of sodium induced many clinical observers to revert to the use of salicin in the treatment of acute rheumatism. The observations of Professor Charteris, and the introduction of pure artificial salicylic acid and salicylate of sodium, will in all probability lead ultimately to the comparative disuse of salicin, although there will doubtless be differences of custom in this respect amongst physicians, the tendency being to use the preparation, which in the hands of the particular individual has appeared to give the best results. Dr. Maclagan is accustomed to give thirty-grain doses of salicin every hour for six hours, and then every alternate hour for twelve or twenty-four hours, when the pain usually subsides. He believes that, to do any good, it is necessary to get a large quantity of the drug into the system rapidly.

Salicin is of some value in malarial diseases, but it is inferior in this respect to quinine.

For some time past salicin, salicylate of sodium, and salicylic acid have been extensively employed as preservatives for preventing the fermentation and decomposition of various articles of food. Salicylic acid, from its powerful antiseptic properties and slight taste, is especially adapted for this purpose. It is employed in very minute quantities for preserving the lighter kinds of sherry, British wines which do not contain more than ten per cent. of alcohol, German beers, temperance beverages, lime juice, lemon juice, milk, cream, jam, and a variety of articles which without the addition of some preservative would speedily undergo decomposition. In one case in which I was engaged the vendor was summoned before the magistrate for selling orange wine containing 0·038 per cent. of salicylic acid, equivalent to 26·6 grains to the gallon, and it was contended that such addition was injurious to health. Professor Corfield, on behalf of the prosecution, stated that the chief use of salicylic acid was as an external application, and proceeded to argue that as salicylic acid was a useful application for corns, it must exert an injurious effect on the human organism. He omitted to state, however, that the preparation commonly employed for removing corns is a one in eight solution in collodion mixed with Indian hemp, and that there is a vast difference between the action of a strong solution, such as this, and the extremely dilute solution to which objection was made. I have often taken at a single dose, absolutely without inconvenience, as much salicylic acid as there is in half a gallon of this orange wine, and have not the slightest hesitation in saying that in the proportions in which they are respectively present in preparations such as these, alcohol is a much more toxic agent than the salicylic acid. If I took at a dose three bottles of orange wine, I should undoubtedly experience some inconvenience from the alcohol, but none from the

salicylic acid. The attempt to prove that salicylic acid was a cumulative agent, and that in small doses it exerted an irritative action on the bladder, was equally futile. The fact is that salicylic acid, taken in the proportion of 0·038 per cent. even for months at a time, could not by any possibility exert any physiological action or produce any injurious effect.

IPECACUANHA.

The dried root of Cephaëlis Ipecacuanha, obtained chiefly from the Brazils.

1. History.

Towards the end of the seventeenth century, ipecacuanha obtained in Paris a great reputation for the cure of dysentery. A merchant named Garnier, who had been attended through a long illness by a physician, as a mark of respect and gratitude made him acquainted with a drug obtained from the Brazils, which was regarded as an absolute specific for dysentery. The physician being old and disinclined to try new remedies, transferred his interest in it to his nephew Helvetius, who, not seeing his way to making any money with it on orthodox lines, decided to run it as a patent medicine. By dint of judicious advertising it caught on, and when the Dauphin, the son of Louis XIV., contracted the disease, Helvetius sold the secret of the composition to the Court physicians for the sum of one thousand pounds. Helvetius, having realized a fortune, became a respectable member of the medical profession, and wrote a learned treatise on the drug.

Ipecacuanha is one of the few drugs which has had the honour of being immortalized in verse. The following lines are worth rescuing from oblivion :—

"Walking in a shady grove
With my Juliana,
Lozenges I gave my love,
Ipecacuanha.

"From a box the imprudent maid
A score or two did pick,
Then, sighing tenderly, she said,
'My Damon, I am sick.'"

2. Active Principles.

Its active principles are:—

(1) *Emetine* or *Emetia.*—A pale, brownish, amorphous mass, sparingly soluble in water and ether, and freely soluble in alcohol, chloroform, and dilute acids. It is also obtainable in white crystals, which turn yellow on exposure to light. It does not form any distinctly crystalline salts.

(2) *Cephaëlic* or *Ipecacuanhic Acid.*—A glucoside allied to tannic acid.

3. The Preparations.

The official preparations of ipecacuanha are:—

1. Vinum Ipecacuanhæ, made with Sherry.

2. Pulvis Ipecacuanhæ Compositus, Dover's Powder. Contains one grain of ipecacuanha and one grain of opium in ten grains of the powder.

3. Trochisci Ipecacuanhæ. Contain a quarter of a grain in each.

4. Pilula Ipecacuanhæ cum Scillæ. Made with Dover's powder, squills, and ammoniacum.

Ipecacuanha, deprived of its emetine, is now frequently used as a therapeutical agent. It has been found of much value in the treatment of dysentery, and has a very decided advantage over the ordinary ipecacuanha in not producing nausea, vomiting, and depression. It should be specially

prepared, and care should be taken to see that the dried spent marc of ipecacuanha wine is not substituted. It is usually prescribed as the *Pulvis Ipecacuanhæ sine Emetinæ.*

4. Physiological Action.

The chief action of ipecacuanha is as an emetic and expectorant.

It is a mild, tardy, and somewhat uncertain emetic. Powdered ipecacuanha is much more efficacious than the wine. It produces repeated vomiting, unaccompanied by much nausea or prostration. Nothing positive is known as to its mode of action, but it is probable that it acts on the peripheral termination of the pneumogastric.

Schmiedeberg says:—"Nothing certain is known about the origin of the vomiting. The idea that it is brought about reflexly through peripheral irritation of the centripetal nerves of the digestive organs has just as much to be said for it as the idea that emetics stimulate the centrally situated parts, or, in other words, the centre of vomiting."

It produces an increased secretion from the bronchial mucous membrane. This may be secondary to its action as an emetic, but it is more likely that it exerts a direct influence. It has been found that in cases of chronic bronchitis it acts admirably as an expectorant when applied locally in the form of a spray.*

Some people are peculiarly susceptible to the action of ipecacuanha, especially when inhaled. This idiosyncrasy is extremely inconvenient to those who, from the nature of their employment, are brought much in contact with the drug. The story is told of a lady, the wife of a surgeon, who could always tell when her husband was making up a medicine containing ipecacuanha, from the distressing tightness in the chest which she experienced. If, by any

* Ringer and Murrell, *Lancet*, 1874, vol. ii.

chance she happened to enter the surgery, even for a moment, whilst the drug was being powdered, she would be almost immediately affected with violent and protracted sneezing. Sometimes this was followed by shortness of breath, cough, and spitting of blood. Sometimes the paroxysms would last for days, the subsequent exhaustion being so great as to threaten the life of the patient. Sir Thomas Watson says:—"I recollect a servant employed in the laboratory at St. Bartholomew's Hospital, when I was a pupil there, who had the peculiar ill-luck to be liable to this affection. Whenever the drug was under preparation he was obliged to fly the place. This idiosyncrasy is not very uncommon. A very small quantity of ipecacuanha dust is sufficient in such persons to bring on a paroxysm of extreme dyspnœa, wheezing, and cough, with singular anxiety and great weakness. The distress usually terminates by a copious expectoration of mucous."

Some people, although unsusceptible to the action of ipecacuanha, suffer severely from exposure to linseed and scammony. Powdered colocynth has a similar effect, and an epidemic of sneezing, which occurred in a house, was traced to the use of the "bitter-apple," which had been powdered over the carpet and other articles to keep out the moth.*

Ipecacuanha in frogs gives rise to irregularity of the heart's action, and finally arrests it in a condition of diastole.

In mammals, and especially in dogs, ipecacuanha gives rise to intestinal symptoms, and this occurs equally whether the drug be given by mouth or injected subcutaneously. The stools are blood-stained, and the intestinal mucous membrane is swollen, red and ecchymosed, as in poisoning by arsenic, antimony, platinum, and iron. This action of

* "Remarks on Paroxysmal Sneezing." Murrell and Ringer, *British Medical Journal*, June 16 and 23, 1888.

the drug on the intestine is of interest in connection with its employment in the treatment of dysentery.

Ipecacuanha has the reputation of being a diaphoretic, and undoubtedly exerts this effect when given in combination with opium in the form of Dover's powder.

5. Therapeutics.

Ipecacuanha is usually regarded as almost a specific for dysentery. It should be given as the powder in doses of twenty, thirty, or even sixty grains suspended in two drachms of syrup of orange and half an ounce of water. No other fluid of any kind must be taken, and the patient should be kept lying down with a chloroform poultice on his abdomen. There may be a little nausea, but when these precautions are observed vomiting rarely occurs. The dose may be repeated in six or eight hours.

This is an example of the large dose action of ipecacuanha, and we have an equally striking example of the small dose action in the readiness with which drop doses of ipecacuanha wine, administered hourly, or even more frequently, check certain forms of vomiting. These small doses are efficacious in the morning vomiting of pregnancy and suckling, in the morning vomiting due to alcoholism, in the vomiting of convalescents from acute diseases, in the vomiting of children arising from acute catarrh of the stomach, in the vomiting of whooping-cough, and in many other forms of vomiting. Half a drachm of ipecacuanha wine should be added to four ounces of water, and of this a small tea-spoonful should be given every ten minutes for the first hour, and subsequently hourly, until relief is obtained. This mode of treatment is a certainty, and will not be tried in vain.

The steam atomizer shown in the accompanying illustration will be found useful in the treatment of chronic

bronchitis and winter cough by means of the ipecacuanha spray. It is easy to work, and does not readily get out of order.

STEAM ATOMIZER.

SENEGA.

Senega is the root of *Polygala senega*, a small plant growing wild in the United States. It was originally employed by the Seneca, or Senegaroos Indians, as a remedy for snake-bite, and was introduced into medicine by Dr. Tennant, a Scotch physician of Virginia, in the early part of the last century. Senega, or seneka, sometimes called the seneka rattlesnake root, was at one time largely employed in this country, but its reputation is apparently on the wane.

There are two official preparations, the tincture and the infusion.

Its active principle is senegin, or polygalic acid. It is identical with saponin contained in sarsaparilla, *Saponaria officinalis* and in *Quillaia saponaria* (soap bark), and is allied to digitonin, one of the active principles of digitalis. It is a white powder soluble in alcohol, and readily forms a soapy emulsion when mixed with boiling water. It splits up on boiling into grape sugar and sapogenin.

Senega belongs to the group of the saponins, a class of bodies closely allied to the emetics. To this group belong sarsaparilla, saponaria officinalis, quillaia saponaria and senega.

Senegin applied locally acts as an irritant, anæsthetic, and muscular poison. It produces intense pain when injected subcutaneously, prolonged sneezing when sniffed up the nostrils, and vomiting, diarrhœa, and gastro-enteritis when taken by the mouth. Applied to the intestines it paralyzes the involuntary muscular fibres. It arrests the heart in diastole, and in this connection is antagonistic to digitalis. When absorbed it paralyzes the nerve centres, in addition to the nerves and muscular structures.

Senega is a stimulating expectorant, a diuretic, and to some extent a diaphoretic. Schmiedeberg expresses a decided opinion that it is not the best member of the group to use. He thinks that it would be better in practice to employ quillia bark instead of the nauseous and expensive senega root, as it contains the same active principles and in a much larger proportion.

GLYCERINE.

Glycerine, or glycerinum, is a trihydric alcohol obtained from fats and fixed oils. It is a sweet principle, and contains a small percentage of water.

It is a clear, colourless fluid, oily to the touch, and

without odour. It does not evaporate on exposure, but readily absorbs water from the air. It does not become rancid, and will not ferment spontaneously. When heated it decomposes, giving off an acrid vapour known as "acrolein." It has remarkable solvent properties; iodine, bromine, salicin, arsenious acid, carbolic acid, borax, gallic acid, tannic acid, and most of the alkaloids dissolving in it readily.

Glycerine suppositories made with gelatine, and containing seventy per cent. of glycerine, are official.

In the Pharmacopœia there is a class of preparations known as glycerines. They are of a soothing, astringent, or antiseptic nature. As glycerine is readily miscible with aqueous fluids they act powerfully on the part to which they are applied.

The official glycerines are:—

Glycerinum Acidi Carbolici.
" " Gallici.
" " Tannici.
" Aluminis.
" Amyli.
" Boracis.
" Plumbi Subacetatis.
" Tragacanthæ.

Glycerine is also contained in linimentum iodi, linimentum potassii iodidi cum sapone, mel boracis, pilula aloes et myrrhæ, pilula rhei composita, pilula saponis composita, tinctura kino, unguentum iodi, and in all the lamellæ.

When glycerine is mixed with starch it forms a "plasma," which is used in making pills, and it enters into the composition of the suppositories of carbolic acid with soap, tannic acid with soap, and morphine with soap. With

iodine glycerine forms "iodized glycerine," which has been used as a substitute for cod liver oil in the treatment of phthisis and other wasting affections. "Boroglyceride," largely employed for preserving fish, meat, and milk, is made by heating together ninety-two parts of glycerine and sixty-two parts of boracic acid. Glycerine of borax is not a mere solution, as it has an acid reaction, and, when mixed with an alkaline carbonate, gives off carbonic acid. Glyco-gelatine is a mixture of glycerine and gelatine, and is used as a basis for lozenges and "pastils."

The term glycerine is not a happy one, for the termination "ine" is usually reserved for alkaloids. In the United States Pharmacopœia the preparations which we name "glycerines" are called "glycerites."

Large doses of glycerine administered to dogs produce loss of muscular strength, lethargy, vomiting, dryness of the mucous membranes, intense thirst, lowering of the temperature, and death, preceded by coma and convulsions. Post-mortem, intense congestion with softening of the tissues is found in the lung, kidneys, and intestines. These effects have not been observed in the case of man. Small doses administered to guinea-pigs improve the nutrition, there being a marked gain in weight, accompanied by a diminished excretion of urea, but in man glycerine exerts no controlling power over the waste of nitrogenous tissues.

Glycerine has antiseptic properties, a circumstance which explains its value in the treatment of flatulence and certain forms of dyspepsia.*

Glycerine is a laxative, and is especially efficacious as a purgative when injected into the rectum. A glycerine suppository produces almost immediately a copious watery evacuation of the bowels. The torpedo-shaped suppository is useful.

* Ringer and Murrell, *Lancet*, 1880, vol. ii.

Plugs of absorbed cotton wool saturated with glycerine and inserted into the vagina, produce a copious secretion of watery fluid, and are of much value in the treatment of congestion of the uterus. Glycerine pessaries are also employed for this purpose. The following is a useful formula:—

Hydrastin	1 gr.
Glycerine	1 dr.
Gelatine enough to make a pessary.	

This pessary dissolves completely with the heat of the body.

Glycerine exerts a beneficial action on nutrition, but does not increase the elimination of urea. Large doses give rise to a red colouration of the urine, due to the discharge of the colouring matter of the blood.

It is absorbed from the alimentary canal, and probably undergoes oxidation. Only a small percentage is eliminated with the urine. It has practically no toxic action.

NUX VOMICA AND STRYCHNINE.

1. Origin.

By nux vomica is meant the seeds of *Strychnos nux vomica*, a tree low in growth, irregular in figure, and having shining foliage, a native of the East Indies. The origin of the term is obvious, the word vomica, or cavity, having reference to the concavity or hollow on one side of the seed. A popular synonym for nux vomica, or strychnine, is "rat's bane," from its employment as a rat poison. Aconite is called "wolf's bane," hyoscyamus is "henbane," whilst staphisagria is known as "lice bane." The term nux vomica was originally applied to ignatia, the St. Ignatius' bean (*Strychnos Ignatia*).

The fruit of the nux vomica resembles an orange. The seeds are of a light brown colour, circular, flattened, about the size of a shilling, concavo-convex, and furnished with a projection or boss on the convex side. They have a velvety feel from being covered with fine hairs. They have no odour, but an intensely bitter taste. They are hard, and difficult to powder. They are often compared as regards their shape to a Chinaman's hat, and the Germans call them "crow's eyes." The seeds weigh on an average about thirty grains, and one of them is sufficient to cause death. The bark of the tree was at one time used to adulterate angostura bark, and was known as "false angostura." The substitution occasioned much alarm and not a few accidents, and the use of angostura was in some countries prohibited. The fraud is easily detected by the "brucia test," a drop of strong nitric acid giving a red colour with the strychnos bark but not with angostura.

2. Alkaloids.

(1) *Strychnine, Strychnia, Strychnina.*—An alkaloid, now official, discovered in 1818, first in St. Ignatius' beans, and soon after in nux vomica. It is known to exist in at least five species of strychnos, being in each case associated with brucia. It is met with either as a white powder or in the form of crystalline particles of different sizes and of various appearance, sometimes in little pearly scales like mica, and sometimes in octahedra. It has been more than once mistaken, with fatal results, for santonin. The amorphous form is not reliable, as it is very likely to contain brucine as an impurity. Strychnine should not give a red colour with strong nitric acid, a proof that it is free from brucine. It is slightly soluble in water, but its salts are soluble, and it can be readily dissolved by the addition of a few drops

of acid. It has no odour, but a taste which is intensely bitter and may be detected in a solution containing only a grain to the gallon, or in a single drop containing not more than $\frac{1}{5000}$ of a grain. It will impart its bitterness to twenty thousand times its weight of water. The proportion of strychnine in nux vomica varies from one-half to one-quarter per cent. The word strychnos occurs in Pliny, and is probably derived from *στρωννυμι*, to overthrow.

(2) *Brucine, or Brucia.*—The second alkaloid was discovered in 1819, a year later than strychnine. It is met with not only in nux vomica and ignatia, but in other plants belonging to the same genus, the two alkaloids being always associated. Brucine occurs as an amorphous white powder, or it may be in little white acicular crystals. It has a well-marked bitter taste. Like morphine it gives an intense red colour with strong nitric acid, a reaction not yielded by strychnine. It is largely used to adulterate strychnine, but the substitution is readily detected. It has about one-tenth the physiological activity of strychnine. It is not official. It is difficult to get brucine free from strychnine. The proportion of brucine in nux vomica is less than that of strychnine, and is probably not more than one-tenth per cent.

Igasurine.—A third crystallizable base is said to have been discovered in 1853, but its existence is doubtful.

These alkaloids are combined in the plant with an acid known as igasuric or strychnic acid, which is allied to malic acid.

4. Pharmacological Action.

The action of nux vomica and strychnine is practically identical. Brucine has the same action, but is weaker. They act in a similar manner on almost all animals. It is found, however, that it takes ten times as much to kill

chickens as it does other birds. Amongst mammals guinea-pigs are very insensitive to the action of these tetanizers. The age of the animal is an important factor, the older the animal the more it takes to kill it.

When taken in quantities just sufficient to produce physiological effects strychnine induces in man a feeling of restlessness, accompanied by trembling in the limbs and stiffness in the neck and jaw. Dr. Anstie attributed to it the power of producing preternatural acuteness of the senses, hyperæsthesia of the surface, photophobia accompanied with flashes of light before the eyes, and an excessive sensibility to sounds.

In larger doses the symptoms closely resemble those of tetanus. They usually come on in from twenty minutes to half an hour, and are rarely delayed beyond an hour. The first symptoms are uneasiness, with restlessness and pains in the limbs. Shooting pains like electric shocks are experienced in various parts of the body, first in the back and then down the legs and arms. Paroxysmal tetanic contraction of the muscles supervene, and these symptoms rapidly increase in intensity until the whole body is thrown into a condition of rigidity during the paroxysms. The respiratory movements are temporarily suspended, so that the face becomes livid and bloated, the jugular veins stand out, the eyes are staring and prominent, the jaws are firmly clenched, and the pupils are dilated. The body is bent backwards, and rests upon the head and heels in condition of a profound opisthotonos. Ferrier has shown that this position is due to the different strengths of the various muscles of the body. They are all equally contracted, but the stronger overpower the weaker. The powerful extensors of the back and the muscles of the thighs keep the body arched backwards and the legs rigid, whilst the abductors and flexors of the arms and fingers clench the

hands and bend the arms, drawing them close to the body. The corners of the mouth are drawn up so as to produce the *risus sardonicus*. Each paroxysm lasts from a few seconds to a minute, or more. Consciousness is not affected, the mind remains perfectly clear, and the suffering is often very great. The paroxysms are excited by the slightest movement or touch, by a current of air, or even by a loud noise. Death usually ensues rapidly, and should the patient survive for a couple of hours from the onset of the symptoms his chances of recovery are materially improved. The fatal termination may be due to exhaustion from the repeated attacks of convulsions or to asphyxia, from spasm of the muscles of the chest interfering with respiration. The temperature is elevated; in the case of dogs from four to six degrees.

The tetanus of strychnine is due to the action of the drug on the cord. We know that it is not of cerebral origin, for in man the mind remains clear to the last, except, perhaps, in cases where the patient is partly asphyxiated from spasm of the muscles of respiration. It is not due to the action of the drug on the nerves or muscles, for when a frog is injected with the poison and the sciatic nerve of one leg is cut there is no tetanus in that limb, although both nerves and muscles are subjected to the influence of the drug. It is true that after poisoning by strychnine the functions of the motor nerves are depressed, and convey impressions imperfectly, and that the muscles do not contract readily to galvanic stimuli and soon become stiff from *rigor mortis*; but this is due not so much to the direct action of the drug as to the stage of excessive activity through which they have passed during the state of tetanic convulsion. It is probable that a physiological, if not an anatomical, continuity exists between the nerve cells concerned in reflex action, and that they with their processes form a functionally

continuous network marked out into tracts presenting various degrees of resistance to the impulses conveyed to them by the different nerves. The action of strychnine in intensifying reflex action may be explained on the theory that the drug reduces and equalizes the resistance of the network, so that the impulses travel over all the tracts with greater facility.

Strychnine is a respiratory stimulant, exerting its action on the nerve centres which preside over the respiratory movements.

Strychnine gives rise to a decided rise of blood pressure, due to stimulation of the vaso-motor centres. It also increases the peristaltic action of the intestines. It is eliminated with the urine, for the most part unchanged; but a portion becomes oxidized, and is converted into strychnic acid.

It is also eliminated with the fæces and saliva. It is so rapidly eliminated by the kidneys that at the expiration of forty-eight hours not a trace remains.

The tetanus of strychnine differs from iodopathic or traumatic tetanus in several important respects.

In the first place, in strychnine poisoning, the patient is seized with convulsions whilst apparently in the midst of perfect health, and the symptoms come on soon after a meal or after taking something to drink. There are no premonitory symptoms, with the exception of a little feeling of uneasiness or restlessness lasting only a few minutes. In the tetanus of disease, on the other hand, there may be soreness and stiffness of the muscles of the neck and jaws for some hours before the onset of the first convulsion.

In strychnine poisoning the muscles of the jaw are the last to be affected, the trismus being secondary to the muscles affecting the limbs and trunk. In the tetanus of disease trismus comes first, preceding the general convulsive movement.

In strychnine poisoning the muscles of the jaw are relaxed in the intervals between the spasms, whilst in the tetanus of disease trismus is continuous.

In strychnine poisoning the spasm seizes all the muscles of the body simultaneously, whilst in the tetanus of disease the rigidity commences with the jaws and gradually spreads all over the body.

In strychnine poisoning the tetanus is intermittent, there being periods of complete relaxation between the attacks, whilst in the tetanus of disease the spasm is continuous, or if there are remissions they are far from complete, some muscular spasm always persisting.

In strychnine poisoning there is no epigastric pain, whilst in the tetanus of disease epigastric pain is often severe, being due apparently to spasm of the diaphragm.

In strychnine poisoning the patient either dies or is out of danger in a very short time, probably in a couple of hours, whilst in traumatic tetanus life may be prolonged for many days.

It may be as well to remember that iodopathic tetanus is chiefly a disease of tropical climates, and that in cases of traumatic tetanus there is a history of some injury, such as a wound or puncture inflicted by a rusty nail or something of the sort. In traumatic tetanus the symptoms set in from five to fourteen days after the infliction of the injury.

It is difficult to suppose that strychnine tetanus could be confounded with an epileptic attack, and the slightest attention to the symptoms would obviate the possibility of committing so serious an error. It would be almost equally impossible to mistake strychnine poisoning for delirium tremens, for in delirium tremens the patient talks wildly and his mental faculties are evidently obscured, whilst in strychnine poisoning they are preternaturally acute even up to the last.

Nux vomica is allied in action to ignatia, which contains

the same alkaloids, whilst strychnine is allied in action to brucine and thebaine. These substances are often said to be allied in action to picrotoxin, the active principle of cocculus indicus; but the convulsions of picrotoxin are due to the action of the drug on the cerebellum, and not on the cord.

Strychnine in its action is antagonistic to physostigma, chloral hydrate, and the bromides.

5. Therapeutics.

In full doses nux vomica and strychnine are largely employed as nervine tonics. The general custom is to give the tincture of nux vomica with an alkaline mixture, such as gentian and soda, and the liquor strychninæ in acid mixtures containing dilute hydrochloric acid, tincture of calumba, and, perhaps, tincture of capsicum. It must be remembered that the solution of strychnine is more active than the tincture of nux vomica, and that, as a rule, it is not advisable to go beyond five minims at a dose.

From its action as a stimulator of the respiratory centre, it may be given with advantage in cases of bronchitis when the expectoration is difficult.

Strychnine in large doses is frequently employed in impotence, especially in the impotence of old men. It is given with full doses of perchloride of iron, and tincture of cantharides or tincture of capsicum are often added.

Strychnine is given hypodermically in the wasting of the muscles which results from infantile paralysis, in the paralysis following diphtheria, in amblyopia, and in traumatic and tobacco amaurosis. From a twentieth to a twelfth of a grain should be injected every alternate day, taking care to push the needle of the hypodermic syringe well into the muscles. A two per cent. solution is most convenient for use, and may be made by dissolving the nitrate

of strychnine in distilled water. Barwell, who has had much experience of this mode of treatment, has never witnessed any toxic symptoms; but with large doses of strychnine it is just as well to proceed cautiously, especially in the case of children.

Small doses of nux vomica are undoubtedly useful in cases of constipation. From five to ten minims of the tincture should be added to half a tumbler of cold water, and this should be sipped slowly in the morning whilst dressing. It is certain in its action, and there will be a copious evacuation of the bowels immediately after breakfast. It acts by stimulating the involuntary muscular tissue of the intestines. Drop doses of nux vomica every ten minutes for an hour cure sick headache, especially when accompanied by that condition commonly known as biliousness.

BELLADONNA.

1. Introduction.

By Belladonna we mean the leaves and root of *Atropa belladonna*, belonging to the natural order Solanaceæ or Atropaceæ. The terms Solanaceæ or Atropaceæ are not identical, but they are very nearly. The atropaceæ are now regarded by botanists as a sub-order of the solanaceæ. It is a very important natural order from a medical point of view, and contains a number of plants of much value. The following medicinal plants belong to this order:—

1. Atropa belladonna—Belladonna, dwale or deadly nightshade.
2. Hyoscyamus niger—Hyoscyamus or henbane.
3. Datura stramonium—Stramonium, thornapple or Jamestown weed.
4. Solanum dulcamara—Nightshade or bittersweet.

5. Duboisia myoporoides—Duboisia.
6. Duboisia Hopwoodii—Pituri.
7. Capsicum fastigiatum—Capsicum, chillies or red pepper.
8. Nicotiana tabacum—Tobacco.

These are all, with the single exception of Solanum dulcamara, of considerable medicinal importance.

Three of them—belladonna, hyoscyamus, and stramonium—are closely allied in pharmacological action.

Belladonna will be considered first, because it is the typical member of the group. Like aconite, henbane, and a number of others, it is an indigenous medicinal plant. It grows wild in many counties, but it is not common near London. It is found on the moors in Yorkshire, in Kent and in Surrey. At one time it grew so abundantly about the ruins of Furness Abbey as to give rise to the name, the "Vale of the Nightshade."

The word belladonna is of Italian origin, and signifies "beautiful lady," the Italian women being in the habit of using it to dilate their pupils and enhance their charms. The term *atropa* is derived from atropos, one of the evil destinies whose mission in life was to destroy life, and it is supposed to be indicative of the fate of those who come under its influence. The name is of comparatively recent origin, the plant being formerly known as the *Solanum lethale.*

2. Active Principles.

There is only one active principle in belladonna, the alkaloid atropine or atropina. Belladonnine, it is true, is sometimes spoken of, but it is of no practical importance.

The old classification was:—

1. Belladonna—Atropine.
2. Hyoscyamus—Hyoscyamine and hyoscine.
3. Stramonium—Daturine.

Ladenburg has reinvestigated the matter, and says there are only three natural mydriatic alkaloids :—

1. Atropine—which occurs in Atropa belladonna, and Datura stramonium.

2. Hyoscyamine—which occurs in Atropa belladonna, Datura stramonium, Hyoscyamus niger, and Duboisia myoporoides.

3. Hyoscine—which occurs in Hyoscyamus niger.

Duboisine is identical with hyoscyamine.

Daturine is a mixture of atropine and hyoscyamine.

To put it in another form :—

1. Belladonna contains Atropine.
2. Hyoscyamus contains Hyoscyamine and hyoscine.
3. Stramonium contains Atropine and hyoscyamine.
4. Duboisia contains Hyoscyamine.

Atropine can be decomposed in accordance with the equation :—

$$\underset{\text{Atropine.}}{C_{17}H_{23}NO_3} + \underset{\text{Water.}}{H_2O} = \underset{\text{Tropic acid.}}{C_9H_{10}O_3} + \underset{\text{Tropine.}}{C_8H_{15}NO}$$

The three mydriatic alkaloids are isomeric, each answering to the formula $C_{17}H_{23}NO_3$. They can all three be resolved, thus :—

1. Atropine yields tropic acid and tropine.
2. Hyoscyamine yields tropic acid and tropine.
3. Hyoscine yields tropic acid and pseudotropine.

By the action of dilute hydrochloric acid on salts of tropine, a series of artificial alkaloids, or tropeïnes, is obtained. The following belong to this series :—

Hydroxybenzoyltropeïne,
Parahydroxybenzoyltropeïne, and
Orthohydroxybenzoyltropeïne.

Oxytoluyltropeïne, another of the series, is analagous in action to atropine, and is familiar to us as homatropine.

Another tropeine is benzoyl pseudotropeine, a base found in Java coca leaves. It can be prepared artificially, and under the influence of hydrochloric acid splits up into tropine and benzoic acid. Under the name of tropacocaine it is employed in ophthalmic practice as a local anæsthetic.

Atropine is the tropeïne of tropic acid. Belladonnine is the tropeïne of belladonnic acid.

3. Preparations.

The preparations of belladonna are :—

From the leaves—

1. Extractum belladonnæ—Extract of belladonna.
2. Tinctura belladonnæ—Tincture of belladonna.
3. Succus belladonnæ—Juice of belladonna.

From the root—

1. Extractum belladonnæ alcoholicum—Alcoholic extract of belladonna.
2. Linimentum belladonnæ—Liniment of belladonna.
3. Emplastrum belladonnæ—Belladonna plaster.
4. Unguentum belladonnæ—Ointment of belladonna.

There is one preparation of atropine :—

1. Unguentum atropinæ—Ointment of atropine.

The official salt of atropine is the sulphate, and of this there are two preparations :—

1. Liquor atropinæ sulphatis—Solution of sulphate of atropine.
2. Lamellæ atropinæ—Discs of atropine.

These preparations call for but few words of comment. The succus is very useful. There are five official succi—those of Belladonna, Hyoscyamus, Conium, Scoparia, and Taraxacum. The expressed juice of the plant is mixed with one-third of rectified spirit, to keep it from decomposing. In spite of this precaution, the preparation is liable to vary in strength, from the influence on the plant of situation,

soil, or season. The plaster should be an active preparation, and enough belladonna may be absorbed by the skin from it to induce dryness of the mouth and throat, and to excite the characteristic scarlatinal rash. The liquor, like most of the other official liquors, is a one per cent. solution. The lamellæ contain one five-thousandth of a grain in each.

4. Pharmacological Action.

(1) *General action on man.*

The effect of a comparatively small dose is to induce dryness of the mouth and throat, and possibly some disorder of vision.

A full dose produces great dryness of the tongue and roof of the mouth, extending down to the pharynx and larynx, giving rise to frequency and difficulty in swallowing, and exciting a hard, dry cough. The face becomes flushed, the eyes are bright and injected, the pupils are dilated, the sight is dim and hazy, whilst the power of accommodation for distant objects is lost. There is mental disturbance often amounting to decided delirium, the delusions, as a rule, being of a pleasing nature. The patient is extremely restless, and cannot be kept quiet. The skin is dry, and a rash appears closely resembling that of scarlet fever. The prominent symptoms are the dryness of the throat and mouth, the absence of sweating, the rash on the skin, the mental disturbance, and the action on the pupil.

The following table may be useful in indicating the effects produced by different doses of atropine on adults :—

A dose of from $\frac{1}{120}$ to $\frac{1}{60}$ of a grain—Dryness of the mouth and thirst.

A dose of $\frac{1}{30}$ of a grain—Dilatation of the pupils, accelerated pulse, preceded by diminished frequency.

A dose of $\frac{1}{20}$ to $\frac{1}{12}$ of a grain—Headache, dryness of the

mouth and throat, difficulty in swallowing, alteration in the character of the voice, dryness of the skin, faintness, a difficulty in walking, accompanied by excitement and restlessness.

A dose of $\frac{1}{9}$ of a grain—Marked dilatation of the pupils, with disturbance of vision.

A dose of $\frac{1}{8}$ of a grain.—A general condition of intoxication, an inability to stand upright, staggering gait, difficulty in micturating, and diminished sensibility of the skin.

A dose of $\frac{1}{6}$ of a grain.—Intense apathy, unconsciousness or disturbance of consciousness, pronounced hallucinations and delirium.

(2) *General action on the lower animals.*—Some animals are very little affected by belladonna and other members of the group. Pigeons and rabbits, for example, are almost insusceptible to the action of belladonna, and atropine will not dilate their pupils. Belladonna has very little effect on horses and donkeys. In this connection the insusceptibility of children for belladonna will be noted. As a rule, vegetable feeders do not respond readily to its action, the most pronounced effect being observed in the case of flesh-eating animals.

(3) *Action on the Heart and Circulatory System.*—In most animals belladonna increases the frequency of the pulse. The first effect in man is to increase the frequency, fulness, and force of the pulse to the extent of fifty or sixty beats in the minute. Belladonna paralyzes the pneumogastric nerve. This may be due to an action on the trunk of the nerve, or on its peripheral termination, or on the intracardiac inhibitory apparatus. After a full dose of atropine, stimulation of the sinus produces no effect. Applied locally to the frog's heart, it arrests it in systole. The small, pale heart of atropine contrasts forcibly with the large black heart of aconite, which is arrested in diastole. Atropine

stimulates the vaso-motor centre, and so contracts the blood-vessels and heightens arterial pressure.

(4) *Action on the Respiratory System.*—After the administration of large doses of belladonna, respiration is accelerated, and this is due to stimulation of the respiratory centre. The respiratory centre is powerfully stimulated, so that the chest movements become deeper and more frequent. The effect is independent of blood pressure.

(5) *Action on the Nervous System.*—The delirium excited by belladonna indicates that it exerts an action on the cerebral cortex. The symptoms in man consist chiefly of exhilaration of the mental functions, giddiness, restlessness, and automatic chorea-like movements. There is usually loud, disconnected talking, delirium and raving. The delusions are of a pleasing nature, and weeping or lamentation is rare.

Belladonna exerts a special action on the cord. Fraser has shown that when a frog is injected with a thousandth part of its weight of atropine, a condition of perfect paralysis and abolition of reflex action ensues, lasts for four or five days, and is succeeded by a tetanic stage, with tetanic convulsions and excessive excitability of the reflex centres, due to an action on the cord. It has been suggested that this is the result of stimulation of the cord, with accompanying paralysis of the motor nerves. This explanation, however, is unsatisfactory, and it is probable that the action is purely spinal, the drug first abolishing and then intensifying its reflex excitability. The theory is that the normal cord exerts a certain resistive power which, as decomposition sets in, is abolished, and allows the impulses to be conveyed upwards and downwards without stint, giving rise to a condition of tetanus.

(6) *Action on the Muscles.*—The voluntary muscles are not affected, and after systemic death respond freely to

galvanism applied locally. The unsteady gait often noticed in man is due to an action on the cord, or on the motor nerves, and not on the muscles.

It is said that belladonna increases the contractile power of involuntary muscular tissue, but it has been maintained that the increase in the peristaltic movement of the intestines is due to depression of the inhibitory branches of the splanchnics.

(7) *Action on the Glandular System.*—One of the earliest and most notable effects of atropine is dryness of the mouth, from suppression of the secretions of the mucous and salivary glands.

According to Heidenhain's hypothesis with regard to salivary glands, there are two kinds of secretory fibres, one the proper "secretory," the other "trophic," causing an increase in solubility in the stored-up gland substance. On the assumption of the different kinds of secretory fibres there is ground for supposing that there is a third variety—anabolic fibres—causing the formation of fresh substance by the cells. After an injection of sulphate of atropine there is no increase either in the percentage of organic substance of salts in the sympathetic saliva produced by stimulation of the chorda tympani, as there would be if the trophic fibres of the chorda escaped paralysis. It would seem that atropin paralyzes the trophic as well as the secretory fibres of the chorda tympani.

Atropine checks the sweat secretion, by paralyzing the efferent sweat-fibres which accompany the vaso-motor fibres. Stimulation of the sciatic nerve no longer evokes the secretion of perspiration in the paws of kittens.

The lacteal nerve terminations are paralyzed, and the secretion of milk is arrested.

A similar action occurs in the case of the other secretions. The secretion of the pancreas is suppressed, and the quantity

of bile poured out is lessened. The effect on the urinary secretion is somewhat doubtful.

(8) *The Rash.*—Much difference of opinion exists as to the cause of the rash, and as to the frequency with which it appears after the administration of belladonna. Dr. John Harley affirms that "generally it is nothing more than a mere temporary rash, but in rare cases and in persons who are liable to vascular irritation of the skin the redness remains, and its disappearance is attended by slight roughness and desquamation." He mentions two cases, in one of which "the patient was scarlet from head to foot," and another in which, after the fourth dose, there was a "scarlatinous tint of the skin." Dr. Gillespie injected a small quantity of extract of belladonna into the urethra of a patient suffering from stricture, and "in less than five minutes the patient became as red as a lobster." Schmideberg says, "The redness of the skin resembling scarlet fever so often observed, especially in the upper part of the body, and the similar colour with turgescence of the features, are probably connected with increase of the frequency of the pulse, with the increase of the blood pressure caused thereby, and with the simultaneous dilatation of the vessels of the skin."

(9) *Action on the Eye.*—Under the influence of atropine, whether applied topically or indirectly through the circulation, the pupil is dilated and the eye becomes bright, dry, and injected. The power of accommodation is lost, and after large doses intraocular accommodation is lost. When atropine is applied locally so as to affect the pupil of one eye only, the large amount of light entering through the dilated pupil produces contraction of the pupil of the other eye.

The pupil is normally under the control of two antagonistic mechanisms:—

(*a*) A contracting mechanis[illegible] [illegible]re of which

the third nerve acts as the efferent, and the optic as the afferent tract.

(β) A dilating mechanism tonic in nature of which the cervical sympathetic is the efferent channel.

When the third nerve or the optic nerve is cut the pupil dilates from the action of the sympathetic.

When the sympathetic is cut the tonic dilating influence ceases and the pupil contracts.

On stimulating the third or optic nerve the pupil contracts.

On stimulating the sympathetic the pupil dilates.

The dilatation of the pupil produced by the local application of atropine might at first sight be attributed to paralysis of the third.

This view is untenable, for when the third is cut and the pupil dilates under the influence of the sympathetic, the application of atropine produces still further dilatation.

From this it follows that the drug exerts an action on some local mechanism.

This mechanism is not in the ophthalmic ganglion, for atropine exerts its effect after the ganglion has been excised.

It is probably situated in the iris or in the choroid, where ganglionic cells are abundant.

The paralysis of accommodation is due to the paralyzing action of the drug on the terminal apparatus of the oculomotor nerve.

The dilatation of the pupil is most marked in man and in cats and dogs, whilst in frogs it occurs only after large doses. It may be induced in the extirpated eye of the frog.

Of all the tropëin alkaloids atropine is the slowest in inducing its effect on the eye, but it lasts a long time, even many days. Homatropine induces its effects rapidly, but they disappear in a few hours. Hyoscyamine in this respect occupies an intermediate position. These differences depend

probably on the facility of absorption of the drug and on the rapidity of excretion.

(10) *Summary.*—It will be seen that atropine has a somewhat complicated physiological action, for it directly influences the functions of the cerebro-spinal and sympathetic nervous systems. The principal effects produced by it on the former system are paralysis of the sensory and motor nerves, and excitation of the cord. By its action on the sympathetic nerves it influences the contraction of the unstriped muscles. In addition to these general actions it influences in a special manner the functions of the vagi nerves and of the iris, suspending the cardiac inhibitory power of the former and producing contraction of the latter.

5. Therapeutics.

Belladonna is a very valuable therapeutical agent.

In the form of the plaster it is useful in pleurodynia, myalgia, lumbago, and allied affections.

The extract mixed with an equal quantity of glycerine forms an admirable local application for boils, carbuncles, and small abscesses. It should be smeared thickly over the part and covered with lint.

Internally in large doses belladonna is useful in checking the paroxysms of whooping-cough. Even in the case of quite young children ten minims of the tincture may be given every four hours. It is often presented in these cases in conjunction with the bromides.

The tincture of belladonna in this dose is useful in checking the incontinence of urine of children, and rarely fails to afford relief.

Given at bedtime it checks the night-sweating of phthisis. Any preparation of belladonna answers equally well, but in these cases the custom has grown up of giving the

sulphate of atropine in the form of a pill at bedtime in doses of from $\frac{1}{120}$ to $\frac{1}{80}$ of a grain.

Belladonna checks many other forms of sweating, and the liniment made with eau-de-Cologne is a useful application to hands which perspire too freely in hot weather.

Belladonna is usually applied to the breasts, to check the secretion of the milk when it is desired to discontinue suckling, and this simple precaution will often obviate the danger of the formation of a milk abscess.

Small doses of belladonna are useful in the initial stage of all acute febrile diseases. A drop of the tincture in a tea-spoonful of water should be given every ten minutes for the first hour, and subsequently hourly for six or eight hours. It is not a bad plan to give the minim doses of tincture of belladonna with minim doses of tincture of aconite. The skin is moistened, there is often profuse perspiration, the pulse becomes softer, and not infrequently the temperature falls.

6. Antagonisms and Synergists.

Belladonna in general action is allied to hyoscyamus and stramonium, and to homatropine and jaborine. Two minims of one in a hundred and twenty aqueous solution of homatropine rapidly dilate the pupil, the effect passing off in a few hours. Homatropine produces tetanus in frogs, in much the same way that atropine does.* The antagonism of homatropine for muscarine is very marked. Homatropine also antagonizes pilocarpine.

Belladonna and atropine in their actions on the secretions are antagonistic to jaborandi and pilocarpine, and also to muscarine and to picrotoxine. Atropine is a much more powerful alkaloid than pilocarpine, so that atropine antagonizes pilocarpine more readily than pilocarpine does atropine.

* Murrell, "Practitioner," vol. xxv. p. 252.

On the frog's heart atropine is distinctly antagonistic to muscarine, to pilocarpine, to aconitine, and to digitalin.

Belladonna and opium are in some respects antagonistic. This antagonism is partly real and partly apparent only. A real antagonism exists in their effects on the convolutions, on the respiratory centre, and perhaps on the intestines. The antagonism on the pupil is only apparent. Opium contracts the pupil in virtue of its effects on the basic ganglia, whilst the dilation caused by atropine is due, as already pointed out, for the most part to paralysis of the ciliary branches of the third nerve. Opium, when it induces sweating, acts on the centres, whilst belladonna checks it through its action on the peripheral terminations of the nerves. This partial antagonism is of value, and atropine has been employed with success in cases of opium poisoning.

Closely allied in general action to belladonna is the Duboisia myoporoides, a tall shrub growing plentifully in the forest lands of Eastern Australia.

It contains an alkaloid known as duboisine, which is identical with hyoscyamine. The general action of duboisine is practically the same as that of atropine. It dilates the pupil, dries the mouth, arrests the secretions of the skin, gives rise to headache and mental confusion, and antagonizes muscarine and pilocarpine.

HOMATROPINE.

Atropine consists of tropin and tropic acid. Tropin combines with amygdalic acid to form amygdalate of tropin, and this when acted on by hydrochloric acid forms homatropine.

The salt of the alkaloid commonly employed is the hydrobromate.

The physiological action of homatropine is similar to that of atropine, but it is less powerful and less prolonged.

Two minims of a one in a hundred and twenty aqueous solution of hydrobromate of atropine dropped into the eye rapidly dilate the pupil. There is dimness of vision, due to paralysis of accommodation. Fourteen hours later the pupil has nearly regained its normal size.

A toad weighing twenty-two and a half grammes was injected with a sixth of a grain of the hydrobromate. It presented symptoms of paralysis in the posterior extremities in twenty-five minutes, and tetanus commenced in an hour and ten minutes. The tetanus and paralysis lasted four days, and the animal recovered completely.

The antagonism of homatropine for muscarine is very marked. A toad was pithed and the thorax opened. The heart was beating well, forty-four in the minute. On the application of a one in four solution of extract of muscarine it became feeble, and fell in five minutes to twelve, in nine minutes more it was six, and in twenty-nine minutes it stopped. Homatropine was then applied; in a minute the heart commenced beating; in three minutes it was contracting strongly, twenty-two in the minute.

Homatropine antagonizes pilocarpine. A young woman with aphonia was given an injection of a third of a grain of nitrate of pilocarpine. Whilst sweating profusely, she had an injection of five minims of a one in sixty solution of homatropine ($\frac{1}{12}$ gr.), and in three minutes the perspiration ceased.

A young man was given hypodermically ten minims of a one in sixty solution of the hydrobromate. In a few minutes he became extremely unsteady in his gait, and complained of feeling giddy. This passed off in about four hours.

Homatropine dries the mouth, and checks the night sweating of phthisis. As an anhydrotic it is inferior to atropine.

I gave fifty hypodermic injections of a tenth of a grain each of homatropine to sixteen patients suffering from the night-sweating of phthisis, and although the results were good, they were not better than were obtained from the administration of either Dover's powder or picrotoxin.

Homatropine may be conveniently given in the form of a pill containing one-sixtieth of a grain. For ophthalmic work it has many advantages over atropine, the chief being the short duration of its effect on the eye. A sixtieth of a grain is the maximum dose which can be given hypodermically with safety.

HYOSCYAMUS.

1. Introduction.

By hyoscyamus we mean *Hyoscyamus niger*, or henbane, an indigenous medicinal plant. The popular name evidently refers to its effect on fowls, "bana" being the Saxon word for slaying or destroying. Thus we have "woolsbane" as a synonym for aconite, "ratsbane" for nux vomica, "licebane" for staphisagria, and many others. In Anglo-Saxon works of the eleventh century henbane is described under the name of henbell. The parts used in medicine are the leaves and branches and flowering tops. The plant is a biennial, and it is directed that only second year's plants are to be employed.

2. Alkaloids.

Hyoscyamus contains two alkaloids:—

1. Hyoscyamine or hyoscyamia. This alkaloid is obtained also from Atropa belladonna, Datura stramonium, and Datura myoporoides. It is isomeric with atropine and with hyoscine. It is identical with duboisine, and mixed with atropine constitutes what is known as daturine. It may

be split up into tropine and tropic acid. When pure it is in the form of snow-white masses of minute crystals, soluble both in spirit and in water. A substance is sold under the name of amorphous hyoscyamine, which is a mixture of hyoscyamine and hyoscine. It is a dark brown substance, looking like an extract, and has a strong disagreeable odour.

2. Hyoscine. This is a syrupy liquid alkaloid. It breaks up into tropic acid and pseudatropine. It forms salts, of which the best known are the hydrochlorate and the hydrobromate.

3. Official Preparation.

The official preparations of hyoscyamus are :—

1. Extractum hyoscyami—Extract of henbane. A green extract made on the lines of the other green extracts.

2. Succus hyoscyami—Juice of henbane. A reliable preparation, prepared like the other succi.

3. Tinctura hyoscyami—Tincture of henbane. Hyoscyamus also enters into the composition of the pilula colocynthidis et hyoscyami, being introduced in this preparation to prevent the griping of the colocynth.

4. Physiological Action of Hyoscyamus.

The general effects of hyoscyamus closely resemble those of belladonna. It dilates the pupil, dries the mouth, and arrests secretions, flushes the face and produces a rash on the skin. It gives rise to a drunken gait, and excites delirium and hallucinations, but more frequently acts as a narcotic, inducing comatose sleep. As a rule the raging delirium is not present, but there is a desire for rest and sleep, probably due to the hyoscine it contains. The action on the lower animals is somewhat different to that of belladonna, and it is much more fatal to birds and rabbits.

5. Physiological Action of Hyoscyamine.

It is difficult to speak positively as to the physiological action of hyoscyamine, for the simple reason that most of the observations have been made with amorphous hyoscyamine, which is largely contaminated with hyoscine. The pure crystalline alkaloid affects the secretions, the heart and the vaso-motor system, just as atropine does. It is a less powerful mydriatic than atropine, and is a soporific. It differs from atropine, chiefly in the fact that it is a hypnotic and not an excitant.

6. Physiological Action of Hyoscine.

The subject has been carefully worked out by H. C. Wood, of Philadelphia.*

In frogs it produces general motor and reflex paralysis, progressively increasing until death ensues from failure of respiration. There is no late tetanus. Neither the muscles nor the nerves are affected, and paralysis is due entirely to depression of the motor centres in the cord. The sensory nerves are not affected. The chief symptoms are loss of muscular power, disturbance of respiration, and stupor. There is very little effect on the circulation, death being due to asphyxia. Hyoscine does not paralyze the pneumogastrics. In man it produces dryness of the mouth, flushing of the face, and deep sleep associated with semi-delirious mutterings and giddiness. Mydriasis is usually, though not always, pronounced. The respiration is slow and full, and is sometimes of the character known as "Cheyne-Stokes." The skin, so far from being abnormally dry, is often bathed in perspiration. It is asserted that there is a rise in temperature. There is sometimes paralysis of the pharynx, and of the muscles of the larynx. The mydriatic effect

* *Therapeutic Gazette*, Jan., 1885.

is associated with paralysis of accommodation, and the maximum effect is produced in a third of the time required by atropine. Its influence in producing sleep is very marked, and it frequently answers well when morphine causes excitement. Nausea, constipation, and other disturbances of the stomach and alimentary canal are rarely witnessed. The dose of the hydrobromate of hyoscine is, for hypodermic use, from $\frac{1}{300}$ to $\frac{1}{100}$ of a grain. It should be employed with caution, and being tasteless it can be administered by mouth without difficulty.

Hyoscyamus and hyoscyamine have much the same therapeutical action as belladonna and atropine. The extract of hyoscyamus is frequently added to purgative pills to prevent griping.

7. THERAPEUTICS.

Hyoscine has been employed with success as a narcotic. It has been used as a sedative in cases of acute mania, in paralysis agitans, and in chronic alcoholism. It may be given as the hydrobromate in doses of from $\frac{1}{300}$ to $\frac{1}{100}$ of a grain. Wood finds it useful in controlling all forms of sexual excitement, and says that seminal emissions can always be checked by the administration of a pill containing from $\frac{1}{120}$ to $\frac{1}{80}$ of a grain at bedtime.

STRAMONIUM.

1. INTRODUCTION.

The stramonium, or thorn apple, *Datura stramonium*, grows wild in many parts of England, but is not strictly an indigenous plant. It is met with on waste ground near gardens or habitations. Some doubt exists as to its native country, and its early distribution has been much discussed by writers on botany. Some think that it came originally

from America, where it is known as the Devil's Apple or Jamestown Weed, whilst others favour the view that it came to us from the borders of the Caspian. It was cultivated in London towards the close of the sixteenth century by Gerarde, who received the seeds from Constantinople. There are two varieties of this species of datura, one with a green stem and white flowers, and the other with a dark reddish stem minutely dotted with green, and purple flowers striped with deep purple on the inside. The last form is sometimes regarded as a distinct species, and is said to be identical with the *Datura tatula* of Linnæus. Naudin maintains that there can be no doubt as to the existence of two distinct species, for he crossed them and obtained hybrids twice the size of their parents, but in every other respect intermediate in character. Moreover, on cultivating these hybrids they exhibited a constant tendency to revert to their original forms. The species recognized in the Pharmacopœia is the *Datura stramonium*, and the seeds are the only part official. In the Russian, French, Spanish, Portuguese, Danish, and Swiss Pharmacopœias, the leaves are official, and until recently they were recognized by the British Pharmacopœia, but at the last revision they were, for some inexplicable reason, omitted. The official preparations are the extract and tincture, both prepared from the seeds.

In India, the Datura fastuosa is largely used for criminal purposes. The professional poisoners who use the drug are known as "Daturiahs," and some of them are said to be in quite an extensive way of business. The plant grows wild, and they have no difficulty in obtaining it. They usually use the powdered seeds mixed with flour, so that it is readily mixed with food. In special cases they prepare an extract or essence by distillation. Sometimes they give a toxic dose so as to kill outright, but in others they simply hocuss the victim, and, after robbing him, leave him to die

from exposure. These Daturiahs are the legitimate descendants of the Thugs, or Phansigars, a brotherhood of murderers and robbers who waylaid people and strangled them.

2. Active Principle.

Stramonium contains an active principle known as daturine. It is not a simple body, but a mixture of atropine and hyoscyamine.

3. Physiological Action.

The physiological action of stramonium is identical with that of belladonna, whilst daturine has the same action as atropine. The symptoms of poisoning by stramonium differ in no respect from poisoning by belladonna. "The same accelerated pulse, the same elevation of temperature, the same wild delirium, the same increased frequency of respiration, the same widely dilated pupils, the same red efflorescence on the skin, the same restlessness or convulsions occur in both cases, and when the dose has been sufficiently large end alike in abolition of the functions of circulation, respiration, and innervation—stupor, general paralysis, weak rapid thready pulse, threatened asphyxia constituting the phenomena of the closing scene in poisoning for either narcotic." (H. C. Wood.)

4. Therapeutical Uses.

There is one respect in which practically, at all events, stramonium differs from belladonna, and that is in a therapeutical application. The great use of stramonium in therapeutics is as a remedy for asthma, the smoking of datura having been introduced by General Gent in 1802, from India, where it was in use under the native name of *Gharbhah*, meaning "forgetfulness of home," evidently in reference to its physiological action. It soon obtained, as most new

remedies do, the reputation of being specific and infallible, and every one with anything like shortness of breath took to smoking datura, and lauding the new drug with the strange name of Sanskrit origin. As the late Dr. Hyde Salter says:—"Its use has illustrated the general inapplicability of any one remedy to all cases of a disease, and the special caprice of asthma; time has shaken it into its proper place and assigned it its true worth; its original reputation greatly exaggerated its merits, but it will probably always maintain its place amongst the remedies for asthma." It is said that datura ferox gives better results than datura tatula, and that datura tatula is more efficacious than datura stramonium.

In this connection it may be as well to mention some other remedies which are burnt and the fumes inhaled for the relief of asthma. They are:—

(1) *Nitre Papers.*—The common nitre papers are prepared by making a saturated solution of nitrate of potassium in boiling water, and dipping in it pieces of thick white blotting paper. When dry the paper is allowed to burn slowly at the bedside, and is efficacious in relieving the paroxysms of asthma. The dense white fumes given off contain carbonic acid, nitrogen, cyanogen, ammonia, watery vapour, and a little sublimed nitrate of potassium.

(2) *Nitre Tablets.*—These consist of six folds of blotting-paper six inches square, prepared by steeping them in a hot saturated solution of nitre and chlorate of potassium. They should be dried slowly before the fire, or, better still, in the open air. Iodide of potassium may be added if necessary, and when quite dry they may be sprinkled with Friar's Balsam, essence of camphor, tincture of sumbul, or tincture of stramonium. The tablet is folded across, so that it assumes the shape of a tent or the half open-cover of a book. When lighted it burns briskly, producing dense masses of

smoke. These tablets are useful in asthma and chronic bronchitis, and also in the treatment of insomnia.

(3) "*Ozone Papers*," a much advertised preparation, probably contain iodide of potassium in addition to nitre.

(4) *Asthmatic Pastilles* are made in cones, and consist of equal parts of nitre, chlorate of potassium, and lycopodium. They burn slowly.

(5) "*Himrod's Cure*," the "Green Mountain Cure" (Vermont), "Hockin's Cure," and "Bliss's Cure," probably consist of powdered stramonium leaves, lobelia, and black tea, saturated with a solution of nitre. They may be closely imitated by taking two ounces each of stramonium, lobelia, and black tea, and after finely powdering, saturating them with a solution of two ounces of nitre in two ounces of water. When well dried this powder burns freely, giving off fumes which are useful in asthma. In some cases powdered fennel is added with advantage.

The following are good formulæ for *Fuming Inhalations*:—

(*a*)	Powdered nitre	1½ ozs.
	Powdered anise fruit	1 oz.
	Powdered stramonium leaves	2 ozs.
	Powdered sumbul root	1 oz.
(*b*)	Powdered nitre	1½ ozs.
	Powdered anise fruit	1 oz.
	Powdered fennel	1 oz.
	Powdered stramonium leaves	2 ozs.
(*c*)	Powdered nitre	1½ ozs.
	Powdered anise fruit	1 oz.
	Powdered stramonium leaves	2 ozs.
	Powdered benzoin	1 oz.

(*d*) Powdered lobelia, stramonium leaves, black tea, and nitre, equal parts.

(6) *Incense.*—The various forms of incense sold for

ecclesiastical purposes may be found useful in the treatment of bronchitis and asthma. The following are the best formulæ:—

(*a*) Styrax	5 drs.
Benzoin	3 ozs.
Sumbul	1 dr.
Frankincense	5 drs.
(*b*) Powdered cascarilla	1 oz.
Myrrh	$\frac{1}{2}$ oz.
Styrax	$\frac{1}{2}$ oz.
Benzoin	$\frac{1}{2}$ oz.
Frankincense	$\frac{1}{2}$ oz.
Burgundy pitch	$\frac{1}{2}$ oz.
(*c*) Olibanum	2 ozs.
Benzoin	1 oz.

CANNABIS INDICA—INDIAN HEMP.

1. Origin.

The dried flowering tops of the female plants of *Cannabis sativa*. Hemp from which the resin has not been extracted is employed, and that only which is cultivated in India. Hemp grown in this country has no active medicinal properties. American hemp was at one time supposed to be inert, but it is now known that the hemp grown in Kentucky is active.

The "tops" consist of one or more alternate branches with the remains of the flowers, a few ripe fruits, and small leaves pressed together in masses or bundles about two inches long, of a greenish colour, and a peculiar odour.

Several forms of Indian hemp are met with in commerce:—

1. *Gunjah*, or *Gánja*, the [illegible] leaves, and flowers

packed together in bundles. This is the form in which it is sold in the bazaars of Calcutta for smoking.

2. *Bang*, or *Bhang*, consists of the dried leaves, which are of a deep green colour and usually broken, so as to form a coarse powder.

3. *Haschish*, the form used by the Arabs, generally met with in coils. It is from this term that we derive our modern word, "assassin." The Eastern potentates formerly dosed their fanatic followers with this preparation.

4. *Churrhus*, or *Charas*, a greenish-brown, moist, resinous mass, having the peculiar odour of the plant, and consisting of resin mized with the hairs and fragments of the leaf.

Cannabis Indica under these different names has been used in the East from a very early period, but whether its properties were first recognized in Persia or in India it is difficult to determine. On festive occasions large quantities are consumed by almost all classes of Hindus. The Brahmins sell sherbet made with bhang at the temples, whilst religious mendicants collect gunjah for smoking. Shops for the sale of various preparations of Indian hemp are to be found in every town, and are much resorted to.

2. Active Principle.

The resin on which the peculiar properties of the drug depend is soluble in alcohol and in ether, but separates from its solutions on the addition of water. This resin has received the name of cannabin, and has a bitter taste and characteristic odour. Tannate of cannabin is a yellowish brown powder, having the taste of tannic acid. It is reputed to be a hypnotic, but it is not a very active substance, and may be given in doses of from two to ten grains with

perfect safety. Cannabis indica contains in addition to the resin a small quantity of a volatile oil.

3. Preparations.

The preparations of Indian hemp are :—

1. *Extractum Cannabis Indicæ*—Extract of Indian hemp.
2. *Tinctura Cannabis Indicæ*—Tincture of Indian hemp.

Preparations of this drug are as a rule unreliable, and no confidence should be placed in any particular specimen unless its physiological action has been tested. The name goes for nothing.

4. Physiological Action.

Indian hemp is employed chiefly for the production of its intoxicant effects. It may be used in any of the forms already mentioned, but haschish is the favourite. It is usually prepared by boiling the leaves and flowers in water to which fresh butter has been added. The decoction is evaporated to the thickness of syrup, and is then strained through a cloth, the butter in the process becoming impregnated with the resinous principle of the plant. In this form it retains its activity for years, becoming only slightly rancid with age. The taste is not pleasant, and it is consequently taken mixed with spices and other aromatic substances in the form of a confection or electuary.

All preparations of Indian hemp are capable of producing intoxication, the most prominent effect of a large dose being a pleasant delirium, followed by more or less exhaustion. In the case of Orientals the effect is usually of an agreeable or cheerful character. In India it is known as "the increaser of pleasure," "the cementer of friendship," "the cause of a reeling gait," "the laughter mover," and by other terms indicative of its peculiar physiological action. When administered in full doses it induces a feeling

of exhilaration, attended by certain nervous and mental phenomena, which vary with the temperament and idiosyncrasies of the subject, and possibly to some extent with the circumstances by which he is surrounded. The sensations which it produces are as a rule pleasurable, beautiful visions float before the eyes, and there is a sense of ecstasy, "which fills the whole being with laughter." The drug is credited with the power of producing true happiness—an enjoyment purely moral and ethereal. The haschish-eater is happy, not like the gourmand, who has satisfied his appetite, but "like one who has received the tidings of great joy."

A good idea of the general effects of the drug may be gathered from a perusal of Bayard Taylor's description in his "Pictures of Palestine" of the sensations he experienced from taking a dose experimentally. He was not a habitual haschish-eater, and the drug was taken in a caravansary in Damascus, having been freshly prepared by his dragoman. He allowed the paste to dissolve slowly in his mouth, and sat quietly for some time awaiting the result. The first sensation experienced was "a nervous thrill accompanied by a feeling of warmth at the pit of the stomach." The author, in describing his experience, says :—

"The sense of limitation—of the confinement of our senses within the bounds of our own flesh and blood—instantly fell away. The walls of my frame were burst outward and tumbled into ruin; and without thinking what form I wore—losing sight even of all idea of form—I felt that I existed throughout a vast extent of space. The blood, pulsed from my heart, sped through uncounted leagues before it reached my extremities; the air drawn into my lungs expanded into seas of limpid ether, and the arch of my skull was broader than the vault of heaven. Within the concave that held my brain were the fathomless deeps

[redacted]

of blue; clouds floated there, and the winds of heaven rolled them together, and there shone the orb of the sun. It was —though I thought not of that at the time—like a revelation of the mystery of omnipresence. It is difficult to describe this sensation, or the rapidity with which it mastered me. In the state of mental exhilaration in which I was then plunged, all sensations as they rose suggested more or less coherent images. They presented themselves to me in a double form; one physical, and therefore to a certain extent, tangible; the other spiritual, and revealing itself in a succession of brilliant metaphors. The physical feeling of extended being was accompanied by the image of an exploding meteor, not subsiding into darkness, but continuing to shoot from its centre or nucleus—which corresponded to the burning spot at the pit of my stomach—incessant adumbration of light that finally lost themselves in the infinity of space."

The author's curiosity was now in a fair way of being satisfied, and, as he says, the spirit or demon of haschish had entire possession of him. The mental phenomena became even more pronounced.

"The thrills which ran through my nervous system became more rapid and fierce, accompanied with sensations that steeped my whole being in unutterable rapture. I was encompassed by a sea of light, through which played the pure harmonious colours that are born of light. While endeavouring, in broken expressions, to describe my feelings to my friends, who sat looking at me incredulously, I suddenly found myself at the foot of the great Pyramid of Cheops. The tapering courses of yellow limestone gleamed like gold in the sun, and the pile rose so high that it seemed to lean for support upon the blue arch of the sky. I wished to ascend it, and the wish alone placed me immediately upon its apex, lifted thousands of feet above the wheat

fields and palm groves of Egypt. I cast my eyes downward, and to my astonishment saw that it was built, not of limestone, but of huge square plugs of cavendish tobacco! Words cannot paint the overwhelming sense of the ludicrous which I then experienced. I writhed on my chair in an agony of laughter, which was only relieved by the vision melting away like a dissolving view; till out of my confusion of indistinct images, and fragments of images, another and more wonderful vision arose. I was moving over the desert, not upon the rocking dromedary, but seated in a barque, made of mother-of-pearl and studded with jewels of surpassing lustre. The sand was of grains of gold, and my keel slid through them without jar or sound. The air was radiant with excess of light, though no sun was to be seen. I inhaled the most delicious perfumes, and harmonies such as Beethoven may have heard in dreams, but never wrote, floated around me. The atmosphere itself was light, odour, and music; and each and all sublunated beyond anything the sober senses are capable of receiving. Before me, for a thousand leagues, as it seemed, stretched a vista of rainbows, whose colours gleamed with the splendour of gems—arches of living amethyst, sapphire, emerald, topaz, and ruby. By thousands, and tens of thousands, they flew past me, as my dazzling barge sped down the magnificent arcade; yet the vista still stretched as far as ever before me. I revelled in a sensuous elysium which was perfect, because no sense was left ungratified. But beyond all, my mind was filled with a boundless feeling of triumph. My journey was that of a conqueror—not of a conqueror who subdues his race either by love or by will, for I forgot that man existed—but one victorious over the grandest, as well as the subtlest, forces of nature. The spirits of light, colour, odour, sound, and motion were my slaves, and having these I was master of the universe. The fulness of my

rapture expanded the sense of time; and though the whole vision was probably not more than five minutes in passing through my mind, years seemed to have elapsed while I shot under the dazzling myriads of rainbow arches."

An equally graphic account of the effects produced by the drug is given by Dr. H. C. Wood, of Philadelphia, who some years ago made some observations with the American hemp, Cannabis Americana. At about half-past four he took a large dose of the extract. No immediate effect was produced, and about seven he went out to pay a professional call, forgetting all about the drug. He says:—

"Whilst writing the prescription, I became perfectly oblivious to surrounding objects, but went on writing, without any check to or deviation from the ordinary series of mental acts connected with the process, at least that I am aware of. When the recipe was finished, I suddenly recollected where I was, and, looking up, saw my patient sitting quietly before me. The conviction was irresistible that I had sat thus many minutes, perhaps hours, and directly the idea fastened itself that the hemp had commenced to act, and had thrown me into a trance-like state of considerable duration, during which I had been stupidly sitting before my wondering patient. I hastily arose and apologized for remaining so long, but was assured I had only been a very few minutes. About seven and a half P.M. I returned home. I was by this time quite excited, and the feeling of hilarity now rapidly increased. It was not a sensuous feeling in the ordinary meaning of the term; it was not merely an intellectual excitation; it was a sort of *bien-être*—the very opposite to *malaise*. It did not come from without; it was not connected with any passion or sense. It was simply a feeling of inner joyousness; the heart seemed buoyant beyond all trouble: the whole system felt as though all sense of fatigue were for ever banished; the mind gladly

ran riot, free constantly to leap from one idea to another, apparently unbound from its ordinary laws. I was disposed to laugh; to make comic gestures; one very frequently recurrent fancy was to imitate with the arms the motions of a fiddler, and with the lips the tune he was supposed to be playing. There was nothing like wild delirium, nor any hallucinations that I remember. At no time had I any visions, or at least any that I can now call to mind; but a person who was with me at that time states that I once raised my head and exclaimed, 'Oh, the mountains! the mountains!' Whilst I was performing the various antics already alluded to, I knew very well I was acting exceedingly foolishly, but could not control myself. I think it was about eight o'clock when I began to have a feeling of numbness in my limbs, also a sense of general uneasiness and unrest, and a fear lest I had taken an overdose. I now constantly walked about the house; my skin to myself was warm, in fact my whole surface felt flushed; my mouth and throat were very dry; my legs put on a strange, foreign feeling, as though they were not a part of my body. I counted my pulse and found it one hundred and twenty, quite full and strong. A foreboding, an undefined, horrible fear, as of impending death, now commenced to creep over me; in haste I sent for medical aid. The curious sensations in my limbs increased. My legs felt as though they were waxen pillars beneath me. I remember feeling them with my hand and finding them, as I thought at least, very firm, the muscles all in a state of tonic contraction."

The state of double consciousness and the sense of prolongation of time were well marked symptoms in Dr. Wood's case:—

"About eight o'clock I began to have marked 'spells'—periods when all connection seemed to be severed between the external world and myself. I might be said to have

been unconscious during these times, in so far that I was oblivious to all external objects, but on coming out of one, it was not a blank, dreamless void upon which I looked back, a mere empty space, but rather a period of active but aimless life. I do not think there was any connected thought in them; they seemed simply wild reveries, without any binding cord, each a mere chaos of disjointed ideas. The mind seemed freed from all its ordinary laws of association, so that it passed from idea to idea, as it were, perfectly at random. The duration of these spells to me was very great, although they really lasted but from a few seconds to a minute or two. Indeed, I now entirely lost my power of measuring time. Seconds seemed hours; minutes seemed days; hours seemed infinite. Still I was perfectly conscious during the intermissions between the paroxysms. I would look at my watch, and then after an hour or two, as I thought, would look again and find that scarcely five minutes had elapsed. I would gaze at its face in deep disgust, the minute-hand seemingly motionless, as though graven in the face itself; the laggard second-hand moving slowly, so slowly. It appeared a hopeless task to watch during its whole infinite round of a minute, and always would I give up in despair before the sixty seconds had elapsed. Occasionally when my mind was most lucid, there was in it a sort of duplex action in regard to the duration of time. I would think to myself, It has been so long since a certain event—an hour, for example, since the doctor came; and then reason would say, No, it has been only a few minutes; your thoughts or feelings are caused by the hemp. Nevertheless, I was not able to shake off this sense of the almost indefinite prolongation of time, even for a minute. The paroxysms already alluded to were not accompanied with muscular relaxation. About a quarter before nine o'clock, I was standing at the door, anxiously

watching for the doctor, and when the spells would come on I would remain standing, leaning slightly, perhaps, against the doorway. After awhile I saw a man approaching, whom I took to be the doctor. The sounds of his steps told me he was walking very rapidly, and he was under a gas-lamp, not more than one-fourth of a square distant, yet he appeared a vast distance away, and a corresponding time approaching. This was the only occasion in which I noticed an exaggeration of distance: in the room it was not perceptible."

That the patient's intellectual capacity does not suffer when he is roused seems to be abundantly clear from Dr. Wood's statement. When the doctor spoke to him he was able to give him a perfectly clear and collected account of what had happened. He says:—

"I narrated what I had done and suffered, and told the doctor my opinion was that an emetic was indicated, both to remove any of the extract still remaining in my stomach, and also to arouse the nervous system. I further suggested our going into the office, as more suitable than the parlour, where we then were. There was at this time a very marked sense of numbness in my limbs, and what the doctor said was a hard pinch produced no pain. When I attempted to walk upstairs, my legs seemed as though their lower halves were made of lead. After this there were no new symptoms, only an intensifying of those already mentioned. The periods of unconsciousness became at once longer and more frequent, and during their absence intellection was more imperfect, although when thoroughly roused I thought I reasoned and judged clearly. The oppressive feeling of impending death became more intense. It was horrible. Each paroxysm would seem to have been the longest I had suffered; as I came out of it, a voice seemed constantly saying, 'You are getting worse; your paroxysms are growing

longer and deeper; they will overmaster you; you will die." A sense of personal antagonism between my will-power and myself, as affected by the drug, grew very strong. I felt as though my only chance was to struggle against these paroxysms—that I must constantly arouse myself by an effort of will; and that effort was made with infinite toil and pain. I felt as if some evil spirit had control of the whole of me except the will power, and was in determined conflict with that, the last citadel of my being. I have never experienced anything like the fearful sense of almost hopeless anguish and utter weariness which was upon me. Once or twice during a paroxysm I had what might be called nightmare sensations; I felt myself mounting upwards, expanding, dilating, dissolving into the wide confines of space, overwhelmed by a horrible, rending, unutterable despair. Then, with a tremendous effort, I seemed to shake this off, and to start up with the shuddering thought, Next time you will not be able to throw this off, and what then? Under the influence of an emetic I vomited freely, without nausea, and without much relief. About midnight, at the suggestion of the doctors, I went upstairs to bed. My legs and feet seemed so heavy I could scarcely move them, and it was as much as I could do to walk with help. I have no recollection whatever of being undressed, but am told I went immediately to sleep. When I awoke, early in the morning, my mind was at first clear, but in a few minutes the paroxysms, similar to those of the evening, came on again, and recurred at more or less brief intervals until late in the afternoon. All of the day there was marked anæsthesia of the skin. At no time were there any aphrodisiac feelings produced. There was a marked increase of the urinary secretion. There were no after effects, such as nausea, headache, or constipation of the bowels."

The occurrence of local anæsthesia, and the fact that all

the symptoms passed away without leaving any trace of inconvenience are noteworthy facts.

Sometimes the most ludicrous ideas are produced by the use of Indian hemp. One experimenter, whilst under the influence of the drug, thought that he was a steam engine, and suddenly springing from his seat, exclaimed, with a shriek of laughter, "Oh, ye gods, I'm a locomotive." So thoroughly was he impressed with the idea, that, on raising a pitcher of water to his lips, he put it down again without quenching his thirst, saying, "How can I fill my boiler when I'm blowing off steam?" The sense of prolongation of time is very characteristic, evidently due to the immense rapidity of the succession of ideas. The mind measures time by the duration of its own processes, and when an infinitude of ideas arise before it in the time usually occupied by a few, time becomes infinitely prolonged to the mind. It is a lifetime in a minute. A common mental condition is the production of "double consciousness," a sense of having two existences, of being at the same time one's self and somebody else.

Among the early symptoms may be mentioned a sensation of heaviness in the arms and legs. The head feels hot and heavy, the eyes are bright and shiny, and there may be giddiness, with noises in the ears. The general sensibility is also affected, and pricking in the feet or all over the body, with numbness of a pleasurable kind, may be excited. Pressure on the skin not uncommonly excites a sensation of burning. After a time there is anæsthesia, which may be so complete that the patient when standing has no consciousness of touching the ground. Sometimes a cataleptic condition is excited.

Whatever may be the symptoms of the first stage, sooner or later, if the dose be sufficiently large, drowsiness comes on, accompanied by very pronounced anæsthesia and loss

of power, especially in the lower extremities. The pupils are dilated, the pulse is quickened, and the patient sleeps heavily, awaking after a time hungry and without any of the sense of malaise and discomfort which so often follows a dose of opium. There is no constipating effect on the bowels, and the secretion of the kidneys seems to be increased rather than diminished. Cannabis indica never induces dangerous symptoms, and I do not think there is a single case of poisoning on record. I was once asked to see in consultation a case of supposed acute mania, and found that the symptoms were due entirely to some pills containing extract of cannabis indica, which had been prescribed for the relief of headache.

The action on the pulse is uncertain, it is usually quickened and then slowed; and the same occurs with respiration. The temperature rises or falls according as the drug produces muscular movement or sleep. The aphrodisiac action is often very marked.

The effects of cannabis indica on the lower animals are of comparatively little importance. In the case of dogs, there is a stage of exaltation followed by profound sleep. In frogs there is a period of heightened sensibility, followed by one of lessened reflex action, and the functions of the sensory nerves are lessened.

5. Therapeutics.

Cannabis indica is an excellent remedy for megrim or sick headache, and it is somewhat surprising that it is not more frequently employed. The extract may be given in doses of from one-third to half a grain in the form of pill. When the patient suffers constantly from headache, or is liable to an attack on the slightest provocation, a pill may be taken three times a day for many weeks at a time without the slightest fear of the production of any untoward effect.

Should the patient not speedily obtain relief, care must be taken to ascertain that the extract employed is physiologically active. Excellent results are often obtained in these cases from the administration of pills containing four grains of tannate of cannabin, one being given three times a day after meals. In some cases the tannate of cannabin is combined with advantage with a couple of grains of valerianate of zinc.

Cannabis indica is useful in many forms of neuralgia, and in these cases is often given with a thirty-second of a grain of arsenious acid.

In cases of painful menstruation extract of cannabis indica often proves very successful.

Many asthmatics use it with advantage, but I know of no definite rules for its employment in these cases.

DIGITALIS.

1. Introduction.

By digitalis we mean the dried leaves of the *Digitalis purpurea*, or purple foxglove, collected from wild indigenous plants when about two-thirds of the flowers are expanded. It grows wild in almost every county in England, and is a favourite garden plant.

The word digitalis is derived from "digitalinum," a thimble, whilst foxglove is supposed to be a corruption of "foxes' glew," or foxes' music, and to have reference to an old Anglo-Saxon musical instrument, consisting of bells arranged on an arched support.

The drug was not employed in medicine until about the time of the Norman Conquest. For many years it was used empirically, but its real introduction as a scientific remedy is due to Dr. William Withering, Physician to the General

Hospital at Birmingham. It is a hundred and ten years since he published his well-known "Account of the Foxglove and some of its Medical Uses." He worked at the subject for ten years before he felt justified in giving to the world the fruits of his experience. It appears from the preface to his monograph that, in 1775, he was requested to give an opinion on the value of a family recipe for the cure of dropsy. Its composition was known only to an old Shropshire woman, who often accomplished cures when orthodox practitioners failed to afford relief. The effects produced were said to be violent purging and vomiting, the diuretic action being overlooked. This secret remedy was composed of no less than twenty different ingredients, and a little investigation served to demonstrate the fact that the only one possessing active properties was powdered foxglove leaves. Dr. Withering's interest in the subject was stimulated by hearing that Dr. Cawley, the Principal of Brasenose College, Oxford, had been cured of a pleuritic effusion by the administration of an infusion of the root of this drug, after some of the first physicians of the age had declared that they could do no more for him. He learnt, too, that a person in the neighbourhood of Warwick had a famous recipe for dropsy, the active ingredient of which was supposed to be digitalis, and that in some parts of Yorkshire foxglove tea was highly esteemed for this purpose. He at once commenced making observations on his patients, and at his suggestion it was tried at the Royal Infirmary, Edinburgh, by Dr. Hope and Dr. Hamilton. The results seemed to have been satisfactory, for in February, 1779, Dr. Stokes made a communication on the subject to the Medical Society of Edinburgh. Dr. Withering's observations excited considerable opposition, but he consoled himself with the reflection that "after all, in spite of opinion, prejudice, or error, time will fix the real value upon this discovery

and determine whether I have imposed upon myself and others or contributed to the benefit of science or mankind." The hundred odd years which have elapsed since these words were written have afforded an ample opportunity of proving the inestimable value of the drug.*

2. Active Principles.

A few years ago it was customary to say that digitalis contained one active principle, the glucoside digitalinum or digitalin. This was formerly official, but was removed from the Pharmacopœia in 1885, from the difficulty experienced in defining it. There were at least three different substances known under this name :—

1. *Homolle's digitalin*, a yellowish-white amorphous powder, sometimes met with in small scales, inodorous, irritating to the nostrils, insoluble in water and in ether, but soluble in alcohol and in acids. It is still largely used in France in the form of the *granules de digitaline*. It is a mixture of digitalin and digitoxin.

2. *Nativelle's digitalin*, or crystallized digitalin, occurring in the form of white crystalline tufts of needles, light, and very bitter in taste; insoluble in water and in ether. It consists almost entirely of digitoxin.

3. *Soluble or German digitalin*, composed chiefly of digitaleïn.

The old digitalin of the British Pharmacopœia was almost insoluble in water, and consisted of digitoxin and digitalin in varying proportions, like Homolle's digitalin.

This classification is now antiquated, and Schmiedeberg finds that digitalis contains at least five principles, in addition possibly to their products of decomposition. These

* "The Centenary of Digitalis." By William Murrell. *Lancet*, August 22, 1885.

principles are not alkaloids, and, with the exception of the first, they are glucosides. They are:—

1. *Digitoxin*, insoluble in water, and the chief constituent of Nativelle's digitalin.

2. *Digitalin*, insoluble in water, and the chief constituent of Homolle's digitalin.

3. *Digitaleïn*, soluble in water, and the chief constituent of the German digitaline.

4. *Digitonin.*

5. *Digitin.*

The first three are heart poisons. Digitonin is either identical with saponin, the active principle of soap bark and senega, or is closely allied to it. It splits up when boiled into grape-sugar and sapogenin, and forms a soapy emulsion when mixed with boiling water. Digitin is physiologically inactive.

To sum up:—

(1) Homolle's digitalin = digitalin and digitoxin.

(2) Nativelle's digitalin = digitoxin.

(3) German digitalin = digitaleïn.

And conversely:—

(1) Digitoxin is the chief constituent of Nativelle's digitalin.

(2) Digitalin is the chief constituent of Homolle's digitalin.

(3) Digitaleïn is the chief constituent of German digitalin.

3. Preparations.

There are two preparations of digitalis—the infusion and the tincture.

The infusion is prepared by infusing thirty grains of the dried leaves in ten ounces of boiling distilled water. The strength is a matter of importance. The dose of most

infusions is from one to two ounces, whilst that of the infusion of digitalis is from two to four drachms. The tincture is made with proof spirit.

The action of these two preparations is not identical, and this arises from the difference in the solubility of the various principles of digitalis in water and alcohol respectively. The infusion contains chiefly digitonin, whilst the tincture contains digitalin and digitaleïn. Neither of them contains much digitoxin, but the tincture contains more than the infusion. The preparation usually employed to act on the heart is the tincture, whilst the freshly prepared infusion is the best diuretic. Digitalis often fails to give satisfaction clinically from the wrong preparation being employed.

4. Pharmacology.

It is no easy matter to give a concise account of the action of digitalis, for it is a subject on which there is much difference of opinion.

Large doses excite nausea, vomiting, and diarrhœa, the vomited matter having a grass-green colour from the action of the gastric juice on some of the constituents of the drug. The active principles are not destroyed in the stomach, for the same effects are produced when they are given by the mouth as when injected hypodermically.

The great and characteristic action of digitalis is that it affects the elasticity of the cardiac muscle without at first modifying its contractile power. The immediate effect of this alteration is indicated by the increase in volume of the pulse, although the absolute working power of the heart is neither increased nor decreased. At the same time the quantity of blood driven into the aorta is greater than before, not only at every beat of the pulse but even in a given unit of time, even although the number of pulsations may be diminished. The result is a better filling of the

arteries and an increase in blood pressure. Accompanying this condition there is a slowing of the pulse, due to stimulation of the inhibitory mechanism of the heart. Finally, in conjunction with continuous high pressure, we get irregularity both in the action of the heart and in the frequency of the pulse. Digitalis does not exert a sedative action on the muscular substance of the heart. Although that organ may be beating more slowly it may be doing more work.

The action of the drug on the heart is best studied on the frog. The first distinctive action is a marked lessening in the rate of the cardiac beats, due to prolongation of the diastole. The systole is abnormally energetic, so that the ventricles become white as the last drop of blood is squeezed out of them. The rhythm is much affected, the auricles and ventricles no longer beating in accord. The heart is irregular in its contraction, one part being hard and white from strong contraction, whilst another is dilated. Finally the heart is arrested in systole and dies in this condition. The contracted, irregular heart is characteristic of digitalis and its congeners.

This condition is noticed after division of the vagi, and even after destruction of the spinal cord. It is evident that digitalis acts directly on the heart muscle itself. There is, however, reason to think that the inhibitory activity of the peripheral ends of the pneumogastrics is increased. There is no stage in which stimulation of the vagi will not produce diastole. It is said that a current which applied to the vagi will not arrest the heart in diastole will do so after the administration of digitalis.

In man the effect on the pulse is peculiar. At first it is slowed, then it is made quicker, then it becomes irregular, and finally, when the dose is sufficiently large, it is arrested. There is an increased rise in blood pressure. This might be due to an increase in the power of the contraction of the

heart or to contraction of the arterioles, or to both combined. Schmiedeberg and Boehm both hold that the rise in blood pressure is due entirely to an increased action of the heart, and not all to contraction of the vessels. Brunton, on the other hand, thinks that it is due in great measure to contraction of the arterioles. The mitral slowing of the pulse is due to stimulation of the vagus roots of the medulla and partly to stimulation of the ends of the nerve of the heart. The subsequent rapidity of the pulse is the result of paralysis of the vagus ends. The irregularity is due to the action of the drug on the heart itself.

Wood sums up the action of digitalis by saying that in moderate doses it stimulates the muscular-motor portion of the heart—probably of its ganglia—increases the activity of the inhibitory apparatus, and produces contraction of the arterioles.

Digitalis acts as a powerful diuretic, especially in cases of cardiac disease. This is the result of the increased blood pressure, and if the latter is already at its normal height no increase in the excretion of urine is produced. Most observers state that it has no such power in health, but Brunton, experimenting on himself, found that although small doses had little or no action, marked diuresis followed when the drug was pushed so as to produce symptoms of poisoning. To obtain the action on the kidneys it is necessary, for reasons already explained, to employ a freshly prepared infusion.

Digitalis lowers the temperature of febrile patients, and toxic doses lower the temperature several degrees both in healthy men and in animals. The influence of moderate doses on the normal temperature is uncertain.

Digitalis is said to be an aphrodisiac both in men and women, but this is doubtful. In France it is employed as an abortifacient.

Digitalis exerts what is called a cumulative action. When the blood pressure is at its height the secretion of the urine is arrested. It is to this power of arresting the eliminative function of the kidneys that the cumulative action of the drug is due.

5. Therapeutics.

Digitalis is allied in action to strophanthus, squill, convalaria, apocynum, adonis, and a number of other drugs. Barium in its action on the heart is allied to digitalis.

The action of Digitalis on the heart is antagonized by the belladonna group and by aconite.

It is generally said that digitalis does harm in aortic regurgitation, and that it does good in mitral obstructive disease, but it is better to rely on symptoms rather than on the nature of the valvular lesions for indications for the administrations of the drug. A rough and ready rule which works well in practice is that digitalis is to be given when the pulse is irregular or intermittent and the urine is scanty. Another point to remember is that as a diuretic the freshly prepared infusion is a better preparation than the tincture.

Digitalis is a useful diuretic, especially in Bright's disease, and the following pill given at bedtime will increase the secretion of urine when it is scanty :—

Powdered digitalis	1 gr.
Squill	1 gr.
Blue pill	1 gr.
Extract of henbane	2 grs.

Some years ago Wunderlich and other German observers advocated the administration of large doses of digitalis in the acute specific diseases. He gave from half a drachm to a drachm of the powdered leaves, the dose being spread over

four or five days. Hirtz gave half a drachm a day, and Hankel occasionally as much as one hundred grains a day. I have recorded a case of typhoid fever which suddenly terminated fatally during its treatment by digitalis. The patient was a child ten years of age, and the dose given was nine minims of the tincture—equivalent to a little over a grain of the leaves—every two hours. On the eighth day the dose was increased to twelve minims every two hours, and after taking six doses the patient died, the pupils immediately before death being widely dilated, and the pulse at the radials being so weak that it could hardly be felt. It was the twentieth day of the disease, and the temperature on the evening preceding the fatal termination was 104·8° F. Digitalis undoubtedly lowers the temperature, but other drugs are employed for this purpose with less risk.

The late Mr. Jones, of Jersey, in cases of delirium tremens gave half-ounce doses of the tincture of digitalis, repeating it in four hours, and subsequently continuing the medicine if necessary in two drachm doses. Seventy cases were treated by him in this manner without the production of any alarming symptoms, but other observers were not so fortunate, and in two cases the patient fell back dead, although up to the moment of death there had been nothing to indicate serious danger.

It is decidedly unwise to employ such large doses of digitalis, although, on the other hand, there is in many cases an exaggerated fear of the dangers attending the use of the drug in moderate doses. It must be remembered that if a patient dies suddenly when taking digitalis the death is always attributed to the treatment, whereas if any other drug were given the result would probably be attributed to the disease.

STROPHANTHUS.

1. Origin.

The mature ripe seeds of Strophanthus hispidus freed from the awns. Its native name is Kombé, and it comes from Zambesi and other parts of Africa.

2. Active Principle.

The active principle of strophanthus is strophanthine, which is most abundantly present in the seeds. It occurs in the seeds along with substances of little pharmacological interest, such as albumin and mucilage, and also with other substances, such as resin and extractive matters.

Strophanthin is a very powerful pharmacological agent. As regards frogs, it is three times as active as aconitine, and ten times as active as pseudaconitine. With mammals, however, it is less lethal than either of those alkaloids.

3. Pharmacological Action.

For our knowledge of the pharmacological action of this drug, we are indebted almost exclusively to Professor T. R. Fraser, of Edinburgh, whose papers on the subject will always remain a model for work devoted to the action of drugs.

Strophanthus is a member of the digitalis group, and is essentially a muscle poison.

The action on the skeletal muscles is very marked. Under its influence the muscles become enfeebled, somewhat rigid, affected with fibrilliary twitchings, and finally, non-contractile, pale, and hard. Their reaction is changed from the normal alkaline to acid, and lactic acid can be separated in considerable quantities. Strophanthus paralyzes the muscles chiefly by diminishing their power to relax,

and it then rapidly destroys this capability by producing a condition indistinguishable from that of *rigor mortis.*

The spontaneous fibrilliary twitchings of the muscles, to which reference has been made, are non-rhythmical, increasing contractions, which may be likened to the muscular contractions of the graver forms of chorea. The strophanthus chorea involves in succession independent fasiculi of many single muscles in contrast to the involvement of entire muscles which occurs in true chorea. They are the result of the action of the drug on the terminations of the motor nerves in the muscles.

Strophanthus acts directly on the cardiac muscle, and one of the chief results of this action is an increase of contractility, rendering systole more prolonged and more perfect. After a large dose the systolic type of change is well-marked, and the capability of relaxing is diminished to such an extent that diastole becomes impossible, the heart ceasing to beat with the ventricle so thoroughly contracted that its cavity is almost effaced. The cardiac muscle is so profoundly affected that it passes at once into a state of *rigor mortis.*

When only small doses of strophanthus are given, the heart assumes the diastolic type, and the irritability and contractility of the heart are not destroyed. Even when the heart has been brought to a standstill in a state of diastole mechanical irritation invariably causes perfect contraction, whilst rhythmical contractions occur every now and then spontaneously. Actual loss of contractility occurs only when the largely dilated ventricle, after a long period of suspended action, gradually loses its abnormal dilatation by slowly, and almost imperceptibly, shrinking to normal or subnormal dimensions. Experiments with atropine plus strophanthus show that stimulation of the cardio-inhibitory apparatus is not the cause of the diastolic

condition. It is improbable that it is the result of a direct action on the muscle of the heart, for even in the extreme forms of the diastolic type the contractions are strong and suffice to completely empty the ventricle. It is much more probable that the weakness of the excito-motor nerve structures is the chief cause, and that this action operates simultaneously with the action on the muscle which increases its contractility. The following points have been demonstrated with regard to the action of strophanthus on the heart:—

1. That a systolic type of change is produced by large doses, and a diastolic by small doses.

2. That whatever may be the type, great increase occurs in the movements of the heart by exaggeration of expansion as well as of contraction.

3. That slowing of the rate of contraction is always produced.

4. That the auricular expansions and contractions are increased as well as the ventricular, and most obviously when the type is the diastolic.

5. That the production of this increase in the movements of the heart, constituted by a greater amplitude of diastolic expansion, and a more complete systolic contraction, is significantly emphasized when the action of the drug is produced in an enfeebled and insufficiently acting heart.

6. That in the systolic type of action the reaction of the muscle of the heart rapidly becomes acid, showing that the drug acts on the heart in the same way that it acts on the skeletal muscles.

7. That in the diastolic type the muscle of the heart is neutral or alkaline, even for a considerable time after paralysis of the heart has been induced.

8. That the action of strophanthus on the heart is more powerful than that of any other known drug.

In support of the last statement, it may be mentioned, that strophanthus is three hundred times as powerful as Merck's digitalin, and thirty times as powerful as convallamarin.

Strophanthus exerts little or no action on the blood-vessels.

It exerts no action on the brain.

When applied to the eyes, a solution of strophanthin produces only slight and transitory blunting of sensibility. This incomplete anæsthesia is accompanied by a disagreeable irritation of the eye, especially at the inner canthus, and by a bitter taste in the mouth. No effect is produced on vision accommodation or on intra-ocular pressure.

Neither in frogs nor in rabbits has any distinct effect on secretion been observed after single lethal or non-lethal doses, except that occasionally in frogs there is an increase of the skin secretion.

It is claimed for strophanthus that it is less apt than digitalis to produce accumulative effects, and that it acts with greater certainty and rapidity. The great advantages of strophanthus are:—

1. That it contains an active principle of far greater potency than any that can be extracted from digitalis.
2. That it has little or no action on the blood-vessels.
3. That it produces no gastric disturbance.
4. That it is extremely rapid in its action.

The disadvantages of strophanthus are:—

1. That it is often adulterated with allied but inferior species.
2. That the tincture, as supplied commercially, is variable in strength and quality.

CASTOR OIL.—CROTON OIL.—ALOES AND ALOÏN.—CASCARA SAGRADA.—COLOCYNTH.—ELATERIUM AND ELATERIN.—JALAP.—PODOPHYLLIN.—RHUBARB.—SENNA.

These drugs all belong to the class of purgatives, cathartics, or aperients, drugs, that is, which are employed in medicine to produce purgation or catharsis by increasing either intestinal secretion or peristaltic movement.

Purgatives may be defined shortly as substances which cause intestinal evacuations.

The purgatives derived from the vegetable kingdom correspond to the cutaneous irritants in the nature of their action—the latter produce an irritation of the skin, whilst the former stimulate or irritate the intestines and give rise to increased secretion and peristaltic action.

Purgatives induce their characteristic action by increasing the intestinal secretion and stimulating the peristaltic action of the bowels, so as to allow no time for the re-absorption of the fluid which has been poured out into the bowel.

Some purgatives act on the motor ganglia of the intestines, and act equally well when given hypodermically. This is the case with aloïn, rhubarb, and senna. An infusion of senna injected into the blood induces prompt catharsis.

Almost any irritant not possessing toxic properties might theoretically be employed as a purgative; but volatile drugs, and drugs which are readily absorbed from the stomach, pass into the general circulation at once, and fail to reach the intestines, so that they are unsuited for this purpose.

Many substances, such as castor oil, croton oil, and jalap resin pass through the stomach unchanged, and are not acted on until they come in contact with the alkalies of the

bile and pancreatic juice, and these are efficient as purgatives.

There are many different kinds of purgatives, which may be classified as follows:—

(1) *Laxatives.*—These are the mildest purgatives, and do little more than increase the peristaltic movements and soften the fæces. Of this class we have examples in figs, prunes, honey, treacle, manna, tamarinds, sulphur, magnesia, and castor oil (in small doses).

(2) *Simple Purgatives.*—These are somewhat stronger than laxatives, and their administration is usually followed by one or more copious evacuations, although there is no great increase of secretion from the mucous membrane of the intestines. Examples of this group are found in castor oil (large doses), aloes, rhubarb, cascara sagrada, and senna.

(3) *Saline Purgatives.*—The properties of this group have already been considered in detail. The best examples are the sulphates of potassium, sodium and magnesium, phosphate of sodium, and tartrate of potassium. Most of the natural mineral purgative waters depend for their properties on the presence of these salts in various proportions in solution.

(4) *Hydragogues or Hydragogue Purgatives.*—These are purgatives which excite a copious secretion from the intestinal mucous membranes. The best examples are elaterium, gamboge, and cream of tartar.

(5) *Drastic Purgatives.*—These give rise to a violent action of the intestines, often accompanied by pain and griping. They increase both the intestinal secretion and the peristaltic action. They are closely allied to the hydragogue purgatives, but stimulate the peristaltic action more than the intestinal secretion. Examples are: elaterium, jalap, scammony, colocynth, croton oil, and podophyllin.

[redacted]

(6) *Cholagogue Purgatives.*—These act on the liver and probably on the pancreas, as well as on the intestinal tract. Some drugs act simply as hepatic stimulants, but the members of this group, by their action on the intestines, assist in expelling the bile and preventing its reabsorption. Examples are grey powder, blue pill, calomel, aloes, podophyllin, and perhaps also euonymin and iridin.

A strictly accurate pharmacological classification of purgative agents is difficult, as the active principles of many of those which are of vegetable origin have not as yet been isolated.

The various drugs will now be considered in detail.

1. Castor Oil.

Castor oil is the oil expressed from the seeds of Ricinus communis, the castor oil plant, or Palma Christi. The plant is common in many tropical climates, and in Spain attains a height of from fifteen to twenty feet, with a trunk as big as a man's body. In England it is cultivated as an ornamental plant, and is often sold for destroying flies. The seeds are the size of a small bean, oval, compressed, obtuse at the ends, smooth and polished on the surface, of a light ash colour, and marbled with black spots and veins. The oil is thick, viscid, colourless or of a pale straw colour. It should be nearly tasteless. The best oil is the "cold drawn," expressed, that is, without heat. Castor oil is a good example of a "fixed" as contrasted with a "volatile" oil. It is often adulterated with some cheap bland oil, a drop or two of croton oil being added to make it active. The seeds contain an acid drastic principle, an alkaloid called ricinine, which is not physiologically active, and several fatty acids including ricinoleic acid, which is peculiar to castor oil.

Castor oil is a mild but decided purgative, producing copious fluid fæcal discharges. Its action on the liver is

slight, and if anything the secretion of bile is diminished as soon as the purgative stage is fully established. When rubbed into the skin it is absorbed, and produces its characteristic action. Injected into a vein it induces malaise, nausea, fainting, anxiety, and general dulness and depression without purging. It is probable that it is eliminated with the fæces, but this is uncertain.

It has been stated that castor oil is a galactagogue, but pilocarpine is the only drug which has the power of increasing the secretion of milk in suckling women.

2. Croton Oil.

This is the oil expressed in England from the seeds of Croton tiglium, growing in the East Indies. The seeds resemble castor oil seeds, but are smaller, duller and browner in colour, and are not mottled. The oil is slightly viscid, pale yellow in colour, and acrid to the taste. Its composition is complex, and its active principles have not yet been separated. Crotonol is an oily substance, said to possess the irritant properties of croton oil. It is more probable, however, that croton oil owes its vesicating properties to "croton resin," a hard pale yellow brittle substance, nearly insoluble in water, but freely soluble in alcohol, ether, and chloroform. There is reason to suppose that it is either a lactone or an anhydride of complex structure.

Applied locally croton oil irritates the skin and produces redness, vesication and pustulation, not unfrequently followed by permanent scarring. The irritant action is much increased by the addition of an alkali, such as liquor potassæ. The liniment is a powerful counter-irritant, and is frequently employed as a local application in cases of phthisis and bronchitis. Croton oil may excite an erythema of the skin, even when taken internally. It is a good example of

a drug which acts as an irritant to the skin, and is at the same time a powerful purgative.

Croton oil is a violent, drastic, and hydragogue cathartic. The fact that a drop placed at the back of the tongue speedily evacuates the bowels, renders it especially suitable in cases of insensibility from apoplexy and other causes, when a difficulty is experienced in inducing the patient to swallow other drugs. It exerts very little action on the secretion of bile. In large doses it is a violent irritant poison. Most of the cases of poisoning by castor oil are due to the fraudulent admixture of a small quantity of croton oil to increase the purgative effect.

3. Aloes and Aloïn.

There are two kinds of aloes—Barbadoes aloes, obtained from Aloë vulgaris, and Socotrine aloes from Aloë Perryi and other species. The drug is procured by making transverse incisions into the bases of the leaves. The medicinal effects vary but little, but Barbadoes aloes is slightly more active.

Aloes enters into the composition of a great number of preparations, including the compound colocynth pill, the compound rhubarb pill, the compound gamboge pill, the pill of aloes and myrrh, and many others. In fact, with the exception of blue pill, compound calomel pill, and the compound scammony pill, there are few laxative pills which do not contain aloes. The compound decoction of aloes is popularly known as "baume de vie." The pill of aloes and myrrh contains saffron, and is called Rufus's pill, from its red colour.

The most important constituent of aloes is a neutral bitter principle known as aloïn. It is described in the *Pharmacopœia* as a "crystalline substance." It is very sparingly soluble in cold water, but dissolves readily in hot

water and in rectified spirit. Were it not for its insolubility in cold water, aloïn would be largely employed hypodermically as a laxative. There are three varieties of aloïn —barbaloïn, socaloïn and nataloïn, obtained respectively from the Barbadoes, Socatrine and Cape aloes. Squibb says that the various kinds of aloes differ as much from each other as do the alkaloids of cinchona bark, but this view is not generally held, and they are probably pretty much alike in their action. The aloïn of commerce is usually in tufts of bright yellow acicular crystals. Aloes also contains a resinoid body, which differs from ordinary resins in being soluble in boiling water. Aloetic acid and a volatile oil are also mentioned.

Most observers state that aloes exerts a laxative action by whatever means it is introduced into the system, and maintain that it acts equally well whether taken by mouth, rubbed into the skin, or injected hypodermically. Others are of opinion that it fails to exert any action unless brought into contact with the bile, and in support of this view point out that an enema of aloes exerts no more action than an enema of water, unless previously mixed with ox-bile, when it acts as a powerful irritant. As throwing some light on the subject, it may be pointed out that a hypodermic injection of aloïn acts as a laxative, and that powdered aloes sprinkled on the blistered surface is an efficient purgative. It is generally admitted, too, that when aloes is administered to a suckling woman it purges the child at the breast. Some authorities are of opinion that the specific action of aloes is exerted solely on the colon and rectum, and that it is a simple evacuant of fæces, whilst by others it is held that its primary action is to increase the secretion of bile, and that the purgative or laxative action is secondary. It is said that aloes is useless in cases of jaundice when there is no bile in the intestines, but it is found

experimentally that large doses of aloes powerfully stimulate the liver of the dog.

Aloes is a tardy laxative, and it may be six, twelve, or twenty-four hours before it operates. It is useless when a prompt action is required. The motions produced by aloes are bulky, a little softened, and not watery. It differs from other purgatives in not producing subsequent constipation. Its habitual use in large doses is said to cause tenesmus, a feeling of weight, heat, and uneasiness in the pelvis, and tendency to the production of piles, but of this there is no proof. It is said, too, that it induces hyperæmia of the uterus, increases the menstrual flow, and produces sexual excitement.

In the lower animals hypodermic injections of aloïn give rise to a peculiar form of inflammation of the kidneys. The tubules lose their epithelium, whilst the glomerili remain intact, but become surrounded by an increase of fibrous tissue. The aloïn can be detected in urine, which often contains albumin.

Aloes is often employed as a "dinner pill," the formula for which is:—

Extract of Barbadoes aloes	2 grs.
Extract of nux vomica	$\frac{1}{2}$ gr.
Extract of gentian	$1\frac{1}{2}$ grs.

These pills are taken once or twice a day, half an hour before meals. They are largely resorted to by elderly people who live well and take but little exercise. They may be taken for years without losing their effect.

An old-fashioned dinner pill, known as Lady Webster's pill, contains:—

Powdered Socotrine aloes	2 grs.
Powdered mastich	$\frac{1}{2}$ gr.
Powdered red rose leaves .	$\frac{1}{2}$ gr.

Lady Heskett's and Lady Crespigny's pills have a similar composition. The formula is a very old one, and it is to be found in the Paris Codex of 1758.

For habitual constipation with anæmia aloes is often given in combination with iron, a favourite formula being:—

Sulphate of iron	2 grs.
Extract of aloes	1 gr.

These pills are given at first three times a day, then twice a day, and finally only once a day. They are efficacious, but it may take a fortnight to produce the desired effect. The addition of the iron is a distinct improvement on the simple aloes pill.

Aloes is the active ingredient in most of the widely advertised "patent medicines."

Holloway's pills consist of aloes, 62 grains; rhubarb, 27 grains; Glauber's salt, 3 grains; pepper, 7 grains; and saffron, 3 grains.

The Sequah's "Prairie Flower" contains in two ounces—Aloes, 105 grains; carbonate of sodium, 35 grains; and water, 735 grains, with a few drops of tincture of capsicum and tincture of myrrh.

"Mother Seigel's Syrup" contains two drachms of aloes in four ounces, with a little treacle, borax, capsicum, and liquorice.

4. Cascara Sagrada.

Cascara sagrada—the sacred bark—is the dried bark of *Rhamnus purshianus.* There are two preparations official, the extract and the liquid extract, but there are a number of "cordials" and other non-official preparations, many of which have a large sale. Cascara contains several resinous bodies, derivatives of chryosophanic acid, and it is also rich in tannin. It is allied in action to Rhamnus catharticus, the

old-fashioned buckthorn, and to Rhamnus frangula, the black alder. It is less drastic than the former, and more active than the latter.

Cascara sagrada is usually described as a "tonic laxative," but I would rather take my tonics and laxatives separately. My experience of one of the most popular liquid extracts of cascara sagrada is that if you take forty minims in water at bedtime it disturbs you before you have finished dressing in the morning, whilst if you take it in the morning it disturbs you at breakfast just as you are reading your paper. It is true it does not gripe, and it produces no straining, but it does not evacuate the contents of the intestines thoroughly, and seems to me to be less satisfactory in its action than a small dose of calomel given in a pill with extract of hyoscyamus. It may be given with advantage with other laxatives. The following is a useful formula * :—

Extract of cascara sagrada	2 grs.
Aloïn	$\frac{1}{5}$ gr.
Strychnine	$\frac{1}{16}$ gr.
Extract of belladonna	$\frac{1}{8}$ gr.
Ipecacuanha	$\frac{1}{16}$ gr.

This is made into a pill—coated or varnished by preference—and one is taken in the morning before breakfast, or three times a day after meals, according to the necessities of the patient.

Buckthorn juice and buckthorn berries are now rarely used. An old writer says:—"They be not meete to be ministered but to young and lustie people of the countrie, which doe set more store of their money than their lives."

5. Colocynth.

By Colocynth we mean the pulp or pith of the *Citrullus*

* Murrell, "Practitioner," vol. xxxix. p. 417.

colocynthis, which grows on the shores of the Mediterranean and also in India. It is the bitter apple or bitter cucumber, and the "wild vine" (literally the vine of the field) of the Old Testament. It was formerly imported from Mogadore unpeeled, but now comes to us from Smyrna, Trieste, France, and Spain, already deprived of its outer covering. The pulp alone is employed, the pips being rejected because they are inert. In some parts of North Africa these seeds constitute an important article of diet amongst the natives.

The active principle of colocynth is the glucoside colocynthin. The pulp contains in addition a good deal of resinous matter.

The preparations of colocynth are a compound extract, a compound pill, and a pill of colocynth and hyoscyamus. The extract of henbane is introduced into the last-named preparation to prevent griping.

Colocynth is a powerful drastic cholagogue purgative. It is commonly given in combination with aromatics and other substances to moderate the violence of its action and prevent griping. It produces copious watery motions which, after large doses, may be serous, mucous, or mixed with blood. It promotes peristaltic action, and often gripes severely. It stimulates the intestinal glands and increases the secretion of bile. In large doses it may produce gastro-enteritis.

The tincture of colocynth of the German pharmacopœia purges if rubbed into the abdomen. Colocynthin acts equally well as a purgative, whether taken by the mouth, injected hypodermically, or introduced directly into the circulation.

It is a diuretic, and when administered to dogs it produces inflammation of the kidneys and bladder.

It is fatal to many of the lower forms of animal life, and is frequently used for the destruction of moth.

When the powdered pulp is inhaled it induces sneezing, and gives rise to irritation of the nostrils. Those engaged in handling the drug often suffer from violent purging.

Colocynth, when administered for its purgative action, is commonly given in combination with other purgatives. The following is a favourite formula for an aperient pill:—

Pilula colocynthidis composita	2 gr.
Pilula hydrargyri	$\frac{1}{2}$ gr.
Extractum hyoscyami	1 gr.
Pulvis ipecacuanhæ	$\frac{1}{3}$ gr.

Colocynth is allied to aloes, but differs from it (1) in its drastic action, (2) in acting on the whole of the intestinal tract, and not solely on the lower bowel, and (3) in the absence of tonic properties.

6. Elaterium and Elaterin.

Elaterium is the sediment of the fruit of the squirting cucumber, *Ecbalium elaterium*, a plant cultivated in Britain. The fruit is cut, and the juice is gently pressed out. The juice is then passed through a hair sieve, and set aside to deposit. The supernatent fluid is poured off, and the sediment is dried on porous tiles in a warm place.

Elaterin is the active principle of elaterium. It is not an alkaloid, but a chemically neutral substance. There is only one preparation of elaterin, the pulvis elaterini compositus.

Elaterium and elaterin are powerful drastic hydragogue purgatives. They increase peristaltic action and the secretion of fluid from the intestines. They induce purgation only when taken internally, and only when brought in contact with the bile. Injected subcutaneously they cause salivation, insensibility, tetanus, and dyspnœa. Large doses taken internally excite inflammation of the stomach, intestines, and peritoneum. Applied locally elaterium acts as an

irritant to the skin, and people engaged in handling the drug and preparing it for market suffer from ulceration of the fingers.

Much of the elaterium of commerce is impure. The best British elaterium contains twenty-six per cent. of elaterin, the worst not more than fifteen per cent. The French elaterium is of an inferior description. The dose of good elaterium is from a sixteenth to half a grain, of elaterin from one-fortieth to a tenth of a grain.

7. Jalap.

The dried tubercules of *Ipomœa purga*, also known as *Exogonium purga*, are imported from Mexico. The drug was named after the city of Xalapa. Jalap resin is obtained from jalap by the action of rectified spirit. It contains convolvulin in combination with another resinous substance known as gammersin.

The preparations containing jalap are an extract, a tincture, and the compound jalap and compound scammony powders.

Jalap is a hydragogue purgative, but purges only when brought in contact with the bile. It increases the solid and watery secretions of the bile, and stimulates the intestinal glands. It may be described as a powerful intestinal stimulant, and as a moderately powerful hepatic stimulant. It exerts no action when injected hypodermically or directly into a vein. It is not an irritant when applied to the skin or to the mucous membranes, and it is not a diuretic.

In general action it is allied to scammony.

8. Podophyllin.

Podophyllin, or resin of podophyllum, is obtained from *Podophyllum peltatum*, the American May apple or mandrake.

The plant grows wild in North America, whence it is imported in large quantities. The rhizome was originally employed as a purgative by the North American Indians. In 1820 it was introduced into the United States Pharmacopœia, and thirty-four years later it found a place in the British Pharmacopœia. The resin podophyllin is a popular purgative, and has a large sale. It is sometimes called "vegetable calomel," or "vegetable mercury," and most of the patent purgative pills, "warranted free from mercury," contain it as one of their chief ingredients. Podophyllin contains two active substances, podophyllotoxin and picropodophyllin, besides fatty and resinous acids. The only preparation of podophyllin is the tincture containing a grain in the fluid drachm. Podophyllin increases the intestinal secretions, and produces copious and rather watery motions. As a purgative it is not only tardy, but is somewhat uncertain in its action. It often gives rise to nausea and griping. Rutherford and Vignal have shown that it has a marked action in increasing the secretion of the liver. It acts on the bowels when injected subcutaneously. Injections of podophyllin into the peritoneum in the lower animals give rise to vomiting, profuse purging, with blood in the motions, and finally produce death from exhaustion. The drug seems to have a special affinity for the duodenum, and, post-mortem, this part of the intestine is found to be inflamed, or even ulcerated.

9. Rhubarb.

Rhubarb is the root, more or less denuded of its bark, of *Rheum palmatum*, *Rheum officinale*, and other species. It is collected and prepared in China and Thibet. The pieces as met with in this country are usually pierced with a hole. This is not caused by the ravages of insects,

as is frequently stated, but is the hole through which the string passes when the pieces are hung up to dry.

Rhubarb contains a number of more or less active bodies :—

1. Chrysophanic acid, met with in the form of brilliant yellow crystals. It is also found in chrysarobin, the araroba or goa powder, a substance largely employed in the treatment of psoriasis and other skin diseases.

2. Chrosophan, a glucoside which readily splits up into chrysophanic acid and sugar.

3. Phaoretin, a resinous body, which is actively purgative.

4. Rheo-tannin, a peculiar form of tannic acid.

5. Oxalate of lime and other mineral salts.

There are several preparations of rhubarb, but the compound pill and the compound powder are the only ones worth remembering.

Dr. C. D. F. Phillips points out that rhubarb affords a striking example of the general, though not universal, law that changes in dosage alter the degree in which a medicament acts upon the body, and when carried beyond a certain point modify its type of action. In small doses rhubarb exerts no purgative action, but acts as a tonic to the digestive functions, increasing the appetite and the powers of assimilation. In large doses it induces none of these tonic effects, but acts as a laxative, the stools being of a loose but not watery consistence, and usually of a yellowish-brown colour. When the laxative action is well marked it is usually followed by a certain amount of constipation, the rheo-tannic acid at this stage exerting its influence.

It is probable that rhubarb affects especially the mucous secretions of the duodenum, and increases the peristaltic action of that particular portion of the intestine. In dogs it acts as a certain, though by no means powerful, hepatic stimulant.

It imparts a yellow colour to the milk of nursing-women,

and also to the urine. Rhubarb urine is distinguished from the urine of jaundice by becoming purplish-red on the addition of an alkali.

10. Senna.

There are two kinds of senna official, the Alexandrian and the East Indian or Tinivelly. The former consists of the leaflets of *Cassia acutafolia*, the latter of the leaflets of *Cassia augustifolia*. Of the preparations the confection, the compound mixture or black draught, the infusion and the popular compound liquorice powder, are the most important. Either kind of senna may be employed for making the preparations. The chief active principle of senna is cathartic acid, a chocolate brown amorphous powder soluble in water and possessing purgative properties.

Senna acts as a laxative or brisk purgative, according to the dose administered. Its sphere of action is exerted chiefly on the small intestine. It stimulates both secretion and peristaltic action. If given alone it sometimes gripes, but it is possible that the griping may be due to the admixture with the senna of other leaves which should have been excluded. Injected into the veins it induces vomiting and purging. It, or its active principle, is eliminated with all the secretions, and the milk of nursing mothers to whom senna is given will purge the child at the breast. Senna possesses none of the tonic effects of rhubarb. Compared with aloes it acts more on the small intestine, whilst on the lower bowel it exerts less effect. Cathartic acid exerts the mild purgative action of the drug, and rarely produces nausea, vomiting, or griping. Being soluble in water, it is easily administered flavoured with syrup of Virginian prune. The dose is five grains for an adult.

CAMPHOR.

1. Origin.

Camphor is defined as a stearoptene obtained from the wood of *Cinnamomum camphora*, the camphor tree or camphor laurel, and it is stated that it is imported in the crude state and purified by sublimation.

This definition calls for some explanation. In the first place, What is a stearoptene?

Proximately, volatile oils consist of two principles, differing in their point of volatilization or congelation, or in composition. The solid constituent is the stearoptene, whilst the fluid constituent is the eloptene. It is impossible to separate them by distillation alone, so as to procure them free from admixture. When they coagulate at different temperatures they may be separated by compressing the frozen oil between folds of porous paper. The solid stearoptene remains behind, whilst the fluid eloptene is absorbed by the paper, from which it may be separated by distillation with water. The solid crystalline substances deposited by volatile oils on standing are also called stearoptenes. Some of them are called camphors, from their resemblance to true camphor, others are oxides or hydrates analogous to the alcohols. Common camphor is the stearoptene obtained from the plant already mentioned, and is a concrete volatile oil.

The *Cinnamomum camphora* is a large evergreen not unlike the linden, and is a native of China and Japan. All parts of the plant evince by their odour the presence of the substance which it secretes. Camphor is also obtained from other plants; in fact, the Borneo camphor, from the trunk of the *Dryobalanopus camphora*, was the first variety introduced into Europe. It is now rarely met with, and is

employed almost exclusively for embalming the Bata chiefs. It is an expensive article, the best specimens commanding five pounds a pound. It is commonly known as borneol, but the term is also applied to Ngai camphor and to a substance prepared artificially from turpentine.

The process of preparing common camphor presents some points of interest. In the first place the root, smaller branches, and, perhaps, portions of the stem are placed with a little water in a large iron vessel, heat is then applied, and the camphor volatilized by the steam is condensed on earthen covers lined with rice straw. This preliminary process varies somewhat in different countries, but the principle is always the same. The crude camphor so obtained is in small grains or granular masses, and is usually dirty and mixed with impurities. It is exported in this state, and is subsequently purified in this country to adapt it for medicinal and general use. The vessels employed for this purpose are made of cast-iron, are circular in shape, and from twelve to fifteen inches in diameter and four inches deep. The sides are perpendicular, and there is a ledge on the top on which the cover rests. In the centre of the cover is a hole, covered loosely by a small hollow cone. To begin with, the crude camphor is mixed with lime, the object of which seems to be to absorb the moisture which would interfere with the regular solidification of the camphor vapour. Heat is then applied until the camphor melts, after which the temperature is carefully regulated so that vaporation takes place without violent ebullition. The camphor condenses on the lower surface of the lid in the form of a solid circular cake. The iron cone is removed from time to time, and the aperture in the cover cleared out with a knife to permit of the escape of any excess of vapour. This affords an explanation of the hole seen at the top of the cakes of camphor.

2. Characters.

Camphor when purified is usually in white concrete crystalline masses, but it is also sold in rectangular blocks and in the form of a powder known as flowers of camphor. It is granular, semi-transparent, tough, and difficult to powder unless previously moistened with a little spirit. The odour is strong, penetrating, and characteristic, whilst the taste is pungent, bitter, and aromatic. It is lighter than water, in which it is sparingly soluble, but it dissolves readily in alcohol, ether, and in fixed and volatile oils. On the application of a moderate heat it sublimes, so that the specimen bottles are usually covered with condensed camphor on the sides least exposed to light. If left exposed to the air it rapidly decreases in weight. It burns readily with a bright flame, giving off clouds of dense smoke. When small pieces of camphor are thrown into a basin of water, they revolve rapidly and move about with more or less velocity in proportion to their size. The movements are supposed to be due to the force exerted by the vapours rapidly exhaled from the camphor on the surface of the water. If a pin point, slightly smeared with oil, is dipped into the water these movements instantly cease, and the particles of camphor are repelled from the pin spot by the spreading film of oil.

There are three modifications of camphor identical in composition and chemical properties, but differing in their action on polarized light. These are: "dextro-camphor," which turns the plane of polarization to the right; "lævo-camphor," which turns it to the left; and an "inactive" camphor, which has no action whatever on polarized light. The common camphor is dextro-camphor. When camphor is heated with nitric acid it is oxidized and converted into camphoric acid. Camphor has been variously regarded as

an alcohol, a phenol, an aldehyde, and a ketone, the last view being the one most generally accepted.

When camphor is rubbed up with certain solid substances they undergo mutual liquefaction and form a fluid. This is the case with chloral hydrate, menthol, thymol, and salol. At the Westminster Hospital there is a preparation largely employed as a local application in the treatment of neuralgia. Its formula is:—

Chloral hydrate	1 part.
Menthol	1 part.
Thymol	1 part.
Camphor	3 parts.

It is painted on the affected part with a brush, and usually affords prompt relief.

3. Preparations.

The official preparations of camphor are:—

Aqua camphoræ.
Spiritus camphoræ.
Linimentum camphoræ.
Linimentum camphoræ compositum.

The aqua camphoræ is simply a weak solution of camphor in water. It is of uncertain strength, the amount of camphor dissolved varying with the temperature at which the preparation is kept. It is the common "camphor mixture" given to hospital patients as a placebo when no definite line of treatment has been devised. It is harmless, and probably possesses no therapeutic virtues. The spirit of camphor is a weak solution in rectified spirit, the liniment is a solution in olive oil, whilst the compound liniment contains a strong solution of ammonia. Camphor is contained in many of t[illegible] ments, such as the

liniments of aconite, belladonna, chloroform, turpentine, and the common soap liniment. It lends its name to the compound tincture of camphor or paregoric, although it plays but a subordinate part in its composition.

By far the most popular preparation of camphor is the essence of camphor commonly known as "Rubini's Solution." It is not official, and is made by dissolving camphor in its own weight of absolute alcohol. It contains about a grain in two minims, and is a thoroughly reliable preparation, being of the greatest use in the treatment of "summer diarrhœa," and the incipient stages of a cold. It should be employed with caution, the dose being from one to five minims every ten minutes or a quarter of an hour, and subsequently less frequently.

4. Physiological Action.

Camphor has a very definite physiological action.

(1) *On Man.*—Applied externally it is a stimulant and rubefacient. A concentrated solution rubbed into the skin soon gives rise to a sense of heat accompanied by local redness. Applied to an abraded surface it excites inflammation.

In small doses taken internally it produces a sense of comfort, accompanied by a feeling of warmth. The pulse may be accelerated, although this is not always the case. Large doses give rise to lassitude, with giddiness, and a lowering of the pulse rate. When from thirty to sixty grains are taken the symptoms are faintness, headache, vertigo, confusion of ideas, burning pains in the stomach, nausea and vomiting, delirium, violent epileptiform convulsions, and maniacal excitement or insensibility, followed by general paralysis. The pulse is usually small, but may be accelerated; the skin is cold, pale, or livid, and covered

with sweat. The beneficial effects which follow the administration of small doses are probably due to stimulation of the cardiac muscle, and of the centre of respiration and nerve centres for the vessels. There is an acceleration of circulation and an increase of blood pressure. The convulsions to which reference has been made, are of an epileptiform nature. Alexander, after taking a dose of forty grains, experienced great mental confusion, accompanied by giddiness, and had a distinct epileptic attack. As a rule, fairly large doses, say up to thirty grains, may be given without inducing anything more serious than giddiness and lethargy. At the same time it should be given with caution, especially if administered in a form in which it is rapidly absorbed.

Camphor is antiseptic, and has obtained a reputation as a prophylactic against contagious diseases, although its virtues in this particular direction are open to question.

There is reason to believe that camphor, taken internally, sometimes induces glycosuria.

(2) *On Mammals.*—In cats laurel camphor produces convulsions which are identical with those of epilepsy, and in one of which the animal usually dies. In rabbits this action is not nearly so definite, nor are the symptoms so pronounced as with cats. In dogs convulsions are not observed, but after large doses the animal exhibits great restlessness and unsteadiness of gait. The nose and ears become markedly hyperæmic from dilatation of the cutaneous vessels. There is no psychical excitement, but as the intoxication proceeds, the animal shows a great tendency to sleep. The sensibility to external impressions is diminished, but the spinal reflexes remain unimpaired. The symptoms must be referred almost entirely to the encephalon, the cord being but little affected, whilst the motor nerves retain their excitability. It will be observed that the symptoms are very similar to those produced by alcohol.

(3) *On Frogs.*—When a frog is placed under a bell-jar in which camphor has been sublimed, a series of symptoms is observed, indicating paralysis of the nervous system. The animal becomes lethargic and exhibits a disinclination to make spontaneous movements, although it jumps well when touched. Soon its movements lack precision, and it falls over on its side when it attempts to jump. The pupils are contracted, and the respiration is slow and deep. After a time respiration ceases, it lies flaccid, and does not turn over when placed on its back. The spinal reflexes during this stage are good, and may be slightly exaggerated, but after a time they cease. The heart continues to beat for some time, but is finally arrested in diastole. From a consideration of these symptoms, it will be seen that in frogs camphor acts chiefly on the nervous system. The primary lethargy indicates early implication of the cerebrum, the loss of co-ordinating power indicates that the optic lobes and cerebellum are involved, whilst the inability to turn over and the cessation of respiration show that the paralysis has extended downwards to the medulla oblongata. Finally, the spinal reflexes are abolished, and the motor nerves lose their excitability.

5. Therapeutics.

Camphor is by far the best remedy we possess for the summer and autumnal diarrhœa which so often assumes a choleraic form. The attack usually comes on suddenly, the patient suffering from persistent purging, often accompanied by vomiting. In half an hour, or even in a shorter time, his face assumes an anxious expression, the features are drawn, the lips are livid, the hands are cold, the pulse is weak or almost imperceptible, and the patient is practically in a condition of collapse. Camphor will set this right in a very few minutes. It is essential to use the

strong solution or essence of camphor, which is a saturated solution of camphor in alcohol. Three minims should be given on a piece of sugar or on crumb of bread, every five minutes. After one or two doses the diarrhœa ceases, the pulse becomes stronger, the colour returns to the face, and the patient is on the high-road to recovery. The cure is completed by giving him two table-spoonfuls of brandy in half a tumblerful of iced milk, which he is directed to sip slowly.

The essence of camphor is almost equally useful in the initial rigour of one of the acute specific diseases and in a severe chill. Inhaled and taken internally it is of service in the early stages of a cold in the head.

6. Allies.

Camphor ($C_{10}H_{16}O$) is closely allied in physiological action to borneol ($C_{10}H_{18}O$) and to menthol ($C_{10}H_{20}O$). This group is closely allied to the alcohol group, the similarity being most marked in the case of menthol. As the number of hydrogen atoms diminishes there is an increased tendency to the production of convulsions of cerebral origin.

There is a derivative of laurel camphor known as monobromide of camphor or monobromated camphor ($C_{10}H_{15}OBr$), which in action is very closely allied to borneol. A few years ago an attempt was made to introduce it into practice, and for a time it was largely employed; but little by little it dropped out of use, and is now rarely prescribed, probably because it is taken with difficulty and is apt to irritate the stomach.

OIL OF TURPENTINE.

1. Origin.

Turpentine is an oleo-resin obtained from various species of pine. The species commonly employed are:—

Pinus australis or *Pinus palustris*, the broom pine or swamp pine of the United States. In the Southern States it is known as the long-leaved pine, yellow pine, or pitch pine. It furnishes by far the greatest portion of the turpentine and tar consumed in or exported from America.

Pinus tæda, the loblolly or oldfield pine, which abounds in the neighbourhood of the coast from Virginia to Florida. It yields turpentine in abundance, but the product is less fluid than that obtained from the last-named species.

Pinus pinaster or *Pinus maritima*, which grows in the southern and maritime parts of Europe. It yields most of the turpentine, pitch, and tar consumed in France.

Pinus sylvestris, from the northern and mountainous parts of Europe. It is identical with the Scotch fir, and yields much of the common turpentine.

Turpentine may also be obtained from other kinds of pine and fir. In some species the oleo-resin exudes spontaneously, but turpentine is usually obtained for commercial purposes by incising or wounding the trunks of the trees. There are many other kinds of turpentine, for example, chian turpentine, the oleo-resin which flows from the trunk of Pistacia terebinthinus, imported from Chio. It was introduced in 1880 as a remedy for cancer of the uterus, but the demand for it is small.

Turpentine is official in the United States' Pharmacopœia, and is employed in the preparation of plasters.

To obtain oil of turpentine the crude turpentine is put

into a still and heat is applied, the distillation being continued as long as any turpentine passes over. The residue is resin, or rosin. On condensing the distillate the oil of turpentine separates from the water, and, after being rectified, is collected in barrels for exportation.

2. CHARACTERS.

Oil of turpentine, commonly known as spirit or spirits of turpentine, is a mixture of several hydrocarbons having the formula $C_{10}H_{16}$. It is limpid and colourless, and has a strong penetrating peculiar odour, a hot bitterish taste, and a neutral or faintly acid reaction. It is slightly soluble in water, less so than most of the other volatile oils, and is readily soluble in ether. It has the peculiar property of absorbing oxygen and converting it into ozone. When pure it consists entirely of carbon and hydrogen, but exposed to the air it absorbs oxygen, becomes thicker and yellowish in colour, and loses much of its activity from the formation of resin. It is highly inflammable, and when brought in contact with a mixture of nitric acid and sulphuric acid, it readily catches fire. When heated with hydrochloric acid it assumes a red colour, a white crystalline substance being at the same time formed which, from its resemblance to camphor, has received the name of artificial camphor. As procured from different sources oil of turpentine shows great difference in optical behaviour. The American and German oils of turpentine turn the ray of polarized light to the right, whilst the French oil of turpentine turns it to the left. It is generally supposed that these two forms of oil of turpentine are identical in action, but they differ somewhat in their mode of action.

3. PREPARATIONS.

The preparations of oil of turpentine are a confection, an enema, a liniment, an acetic liniment, and an ointment.

4. Physiological Action.

When oil of turpentine is applied to the skin it acts as an irritant and rubefacient. It may, especially if evaporation be prevented, act as a vesicant.

Taken internally it produces a feeling of warmth in the stomach, followed in a few minutes by a sense of exhilaration, and if the dose is a large one, by giddiness and a kind of intoxication.

After absorption it causes a rise and then a fall of blood pressure, due in all probability to its first stimulating and then paralyzing the vaso-motor centres. The effect on the pulse is uncertain, for it is sometimes slowed and sometimes quickened in frequency. Doses which have no effect on the blood pressure may increase the frequency of the pulse. This effect is probably due to a direct action on the heart itself. Large doses commonly slow the pulse, and this is believed to be due to stimulation of the pneumogastrics. Respiration is quickened, and a portion of the drug is eliminated by the mucous membrane of the bronchial tubes.

The use of oil of turpentine as an antidote to phosphorus calls for a word of explanation. When it is kept for some time in bottles partially filled with air, it absorbs ozone and acquires the power of converting phosphorus into hypophosphoric acid. It is essential to the treatment of poisoning by phosphorus that the turpentine should contain plenty of ozone, or it will exert anything but a beneficial effect, and will facilitate the absorption of the phosphorus by dissolving it. It is usually said that the French oil of turpentine should be used as an antidote in cases of poisoning by phosphorus, and that the German and American varieties are useless.

The irritant action of oil of turpentine on the kidneys

[redacted]

and genito-urinary organs is very decided. The first symptom is an increase in the amount of urine secreted. This is followed by pain in the back, frequency of micturition, and scalding in the urethra. After a time the quantity of urine secreted is diminished, it contains albumin and is blood-stained. The urine acquires the odour of violets.

Large doses of oil of turpentine are vermifuge, and exert a purgative action.

5. Therapeutics.

As a counter-irritant in the form of a liniment, turpentine is largely employed in the treatment of chronic rheumatism, sprains, sore throat, neuralgia, and a number of painful affections. The following is a useful formula:—

Turpentine liniment	1 oz.
Solution of ammonia	1 oz.
Oil of cajeput	½ oz.
Oil of lemons	1 dr.
Olive oil	to 4 ozs.

In hæmoptysis there is no better remedy than oil of turpentine. It should be inhaled freely from the hands or from a pocket-handkerchief.

Turpentine is useful in the hæmorrhage from the bowels of typhoid fever. Even when there is no hæmorrhage it is useful about the end of the second week, when the tongue becomes very dry, red, chapped, and coated in the centre with a brownish fur, and when in addition there is marked flatulent distension of the abdomen. Ten drops may be given every four hours in mucilage of acacia, mixed with half a drachm of glycerine, and flavoured with two drops each of oil of erigeron and oil of gaultheria.

6. Allies.

There are many substances allied in general action to turpentine. One of the best known of these is pure terebene. It is a clear, colourless fluid, having an aromatic odour, and is made by the action of sulphuric acid on oil of turpentine, and subsequent distillation. It is a powerful antiseptic, and is largely employed in the treatment of flatulence and winter cough.* It may be given internally in ten-drop doses on a piece of sugar or on bread crumb every four hours. It may also be used as a spray, either with a common atomizer, or with the apparatus shown in the accompanying figure.

STEAM ATOMIZER.

"Pinol" is made from the Pumilio pine, growing in Alpine regions above the snow level. In therapeutical action it is closely allied to pure terebene, but is more fragrant. A mixture of pure terebene, pinol and eucalyptol will be found useful in winter cough, not only for internal

* Murrell, "Chronic Bronchitis and its Treatment," 1889.

administration, but to inhale either with or without an apparatus.

Terpin-hydrate is a derivative of oil of turpentine, and is generally met with in prismatic crystals, resembling chloral hydrate. It is very insoluble in water, and is best given in the form of tabloids.

TANNIC ACID.—GALLIC ACID.—KINO.—CATECHU.

These are all astringents. Astringents may be roughly defined as substances which check or dry up secretions. Most of them cause contraction of the tissues to which they are applied, and their action is exerted chiefly on the mucous membranes. Some astringents are purely local, others are remote in their action. Local astringents affect solely the parts to which they are applied, whilst remote astringents act on distant organs after their absorption into the blood. Most of them—the notable exceptions being gallic acid and ergot—coagulate or precipitate albumin.

We have many examples of astringents. Most of the acids exert an astringent action. Alcohol in all forms is distinctly astringent, and so is alum. Many metallic salts are astringent, and good examples are found in sulphate of copper, perchloride of iron, and nitrate of silver. Gallic acid and tannic acid belong to this class, and many vegetable substances which contain these substances, such as kino and catechu, are decided astringents.

Tannic acid and gallic acid are both derived from galls, excrescences found on the small twigs of a species of oak, the *Quercus infectoria*. They are produced by the puncture and deposited eggs of an insect, and are in this sense of animal origin.

Tannic acid, or tannin, is prepared by the action of ether on galls. It is a glucoside, and is met with in the form of

glistening yellow crystals, freely soluble in water and having an astringent taste.

Gallic acid is an acid prepared by the action of sulphuric acid on galls. It is met with in the form of white or pale fawn-coloured acicular crystals, soluble in cold water, and freely soluble in hot water.

Kino is the juice hardened in the sun of the incised bark of *Pterocarpus marsupium*, the Indian kino. It contains kino-tannic acid and pyrocatechin, which differs very slightly from the catechin obtained from catechu.

Catechu is an extract from the leaves and shoots of the *Uncaria gambier*. The method of preparation, although presenting some points of interest, is not given in the Pharmacopœia. The gambier plant is cultivated in Singapore, in plantations which are often formed in clearings in the jungle. These plantations last only a few years, and are then abandoned owing to the impoverishment of the soil and the growth of rank weeds. It is found profitable to combine with the cultivation of gambier that of pepper, for which the boiled leaves of the gambier form an excellent manure. To make catechu the gambier leaves and young shoots are stripped off the plant and boiled with water in a pan for some hours. The decoction so formed is evaporated to the consistence of syrup, which, by a peculiar method of manipulation, is stirred up and ultimately converted into a thick mass resembling soft yellowish clay. This is thrown into shallow square boxes, and is then cut into cubes and dried in the shade. Catechu contains catechu-tannic acid, which differs from other forms of tannin in not being a glucoside.

The preparations of these substances call for but little comment. The glycerine of tannic acid is a useful application for the throat, and is largely employed in chronic tonsilitis, relaxed uvula, and similar affections. The

glycerine of gallic acid answers much the same purpose. The compound kino powder contains opium, and is a favourite remedy for the diarrhœa of phthisis.

These substances belong to the group of the tannins, and in spite of very many essential chemical differences, agree in the fact that they form stable compounds of the nature of leather with the gelatin-yielding constituents of tissues, and at the same time precipitate albumins and gelatin from their solutions.

Tannin applied to the skin deprived of its epidermis coagulates the albumin. It also coagulates the blood, and acts as a styptic. Applied to the mucous membrane it coagulates the mucus, but does not contract the blood-vessels, its astringent action being due to the coagulation of the albumin of the tissues with which it is brought in contact. Taken into the stomach it acts as an irritant, and gives rise to vomiting. Taken in ordinary medicinal doses by the mouth it rapidly combines with the albuminous substances met with in the stomach, and but little of it finds its way into the intestines. It is not improbable that the albuminous compound is again decomposed by the alkali of the blood, and so exerts a remote astringent effect. Substances such as catechu, which contain some form of tannin, guarded by gummy and extractive matters, are not so easily decomposed by the stomach, and pass more readily into the intestines.

Gallic acid differs from tannin, in not coagulating albumin.

Kino is insoluble, and exerts its astringency chiefly on the lower part of the intestine. The value of the compound kino powder in the treatment of the diarrhœa of phthisis is well known.

Tannin breaks up in the blood, and is eliminated by the urine in the form of gallic acid and pyro-gallic acid. When

an astringent action on the kidneys is required, it is better to use gallic acid and not tannic acid, the acid and not the glucoside. Gallic acid passes unchanged into the urine, and has been detected an hour after being taken. Catechu-tannin also passes off in the urine unchanged.

The therapeutical uses of tannic acid and other members of this group will be divined from a consideration of their physiological action. They are employed whenever an astringent or a styptic is indicated. The glycerine of tannin is employed as a local application to eczematous surfaces which secrete profusely.

I have recently employed with much success the following formulæ to check profuse sweating, especially when its odour is offensive:—

Tannin	20 grs.
Pure terebene	2 drs.
Absolute alcohol	to ½ oz.

The other formula is a modification of this:—

Tannin	20 grs.
Oil of pumilio pine	2 drs.
Absolute alcohol	to ½ oz.

The latter is especially a pleasant preparation. Either of them painted on the affected part at bedtime or in the morning will effect a cure in a few days.

Glycerine of tannin is a useful application in relaxed sore throat, and should be swabbed freely all over the affected parts with a large brush. It is not altogether a pleasant mode of treatment, but it is efficacious. Tannic acid is also useful in stomatitis and ulceration of the gums.

Given internally it may be administered with advantage in hæmoptysis, hæmatemisis, and intestinal hæmorrhage. It lessens the amount of albumin passed in albuminuria.

HAMAMELIS.

The hamamelis virginica or witch-hazel is an indigenous shrub of from five to fifteen feet high which grows abundantly in all parts of the United States, chiefly on hills and stony places or on the banks of streams. It is remarkable for the late appearance of its yellow flowers which expand in autumn and continue to blossom until the depth of the winter. The branches have been employed from time immemorial as "divining rods." The bark appears to have been employed by the Indians in the form of a poultice, as a remedy for tumours and inflamed surfaces. The parts used in modern medicine are the leaves and the bark.

The bark contains about seven per cent. of tannin, with a certain amount of resin, sugar, mucilage, and the ordinary constituents of woody fibre. No alkaloid or glucoside has been detected. The substance known as hamamelin or hamamelidin is not an alkaloid, but a resinoid substance made by adding a concentrated alcoholic fluid extract of the drug to a large quantity of water and collecting the precipitate.

The official preparations of hamamelis are the tincture (one in ten) prepared from the bark and the liquid extract (one in one) made from the dried leaves. The ointment of hamamelis is made by mixing one fluid part of the liquid extract with nine parts of simple ointment.

Hazeline, an aromatic colourless fluid preparation distilled from the fresh plant, is a reliable form in which to administer the drug, and has a much larger sale than any of the official preparations.

Respecting the pharmacological action of this drug we are completely in the dark. It has no poisonous action, and even large doses administered to animals produce no effect.

It has been suggested that its therapeutical action is due to the presence of tannin; but, as hazeline is prepared by distillation and tannin is not volatile, this can hardly be the case.

Hamamelis is extensively employed in checking hæmorrhage, especially when venous in character. It is most useful in what is called passive hæmorrhage. It is of much value in the treatment of menorrhagia and dysmenorrhœa.

There is no doubt as to the utility of hamamelis and especially of hazeline in the treatment of bleeding piles. It should be given internally, and employed locally as an ointment. When the bleeding is profuse it may be injected into the bowels.

It is said that hamamelis will cure varicose veins, and I have no doubt that in these cases it is frequently of much benefit and obviates the necessity for an operation. It is slow in its action, and in many cases I have found it necessary to give it continuously for a year or more. I have had patients whom I should not hesitate to call skilled observers, who from personal experience of its effects in the treatment of varicose veins have been convinced of its utility.

The prescription I usually employ is the following:—

Hamamelidin ... ... ½ gr.

To make a pill. One to be taken every three hours.

This substance referred to under the name of hamamelidin is the extract of hamamelis made by Keith and Co., of New York.

The ointment is made with five grains of hamamelidin to an ounce of lanoline ointment, and may be scented with a few drops of oil of rose geranium.

BENZOIC ACID.

Benzoic acid is prepared from benzoin by sublimation. Benzoin is a balsamic resin obtained by making deep incisions in the bark of the *Styrax benzoin*, or Benjamin tree, a native of Sumatra and Java. The name "Benjamin" is probably a corruption of the Arabic term "Lubán Jawi," meaning Java frankincense.

The mode of preparation of benzoic acid by sublimation is worth noting, most acids being prepared by liberating them from their alkaline salts by means of sulphuric acid. Benzoic acid exists in benzoin combined with resin, and is volatilized and then condensed in the upper part of the apparatus employed. The temperature is carefully regulated to prevent the decomposition of the resin. Benzoic acid may also be obtained from the urine of horses and cattle by boiling the hippurate of calcium with hydrochloric acid.

Benzoic acid occurs in the form of light feathery crystalline plates, or needles, having a silky lustre, a warm, acrid taste, and an agreeable aromatic odour, resembling that of the benzoin from which it is obtained. It is sparingly soluble in water, but dissolves readily in rectified spirits, fats, and oils. When mixed with solutions of the alkalies, or with lime, it forms benzoates, from which it may again be separated by the addition of hydrochloric acid.

Benzoic acid is a powerful antiseptic. This fact affords an explanation of the popular use of Friar's Balsam—the Compound Tincture of Benzoin—as an application to wounds.

It is a stimulating expectorant, and this again affords an explanation of the value of Friar's Balsam in the treatment of coughs.

Benzoate of sodium and benzoate of ammonium are powerful hepatic stimulants, but exert no action on the intestinal secretions.

Benzoic acid is a diuretic, and renders the urine acid. In the kidneys it unites with glycin, and is excreted in the form of hippuric acid. That the seat of the change is in the kidneys is demonstrated, as Brunton has shown, by the following experiments:—

1. If you give benzoic acid it is found in the urine as hippuric acid, but in the blood it still remains as benzoic acid.

2. If you give a rabbit hippuric acid it is excreted as such, but is found in the blood as benzoic acid.

3. If you tie the renal arteries and give benzoic acid no conversion into hippuric acid takes place, but if you ligature the ureters the change takes place, and hippuric acid is found in the blood.

It seems probable that the cells of the tubules have the power of effecting a combination between the benzoic acid brought to them by the blood, and the glycin which they form by their own metabolism. Many other bodies taken into the system reappear in the urine combined with glycin, the change in each case taking place through the activity of the cells of the tubules of the kidney.

Benzoic acid is allied in action to salicylic acid and the other acids of the aromatic series.

COPAIBA.

1. Origin.

Copaiba, or copaiva, is an oleo-resin, obtained by incising the bark of *Copaifera Langsdorffii* and other species of the same genus, natives of the warmer climates of South

America. It is a viscid fluid, usually transparent and not fluorescent, but sometimes opalescent and slightly fluorescent. It varies in colour from a light yellow to a pale golden brown. It has a peculiar aromatic odour, and a persistent acrid, somewhat bitter taste. It is soluble in absolute alcohol and in petroleum. From it is obtained, by distillation, the oil of copaiba, a colourless or pale yellow fluid, having the odour and taste of copaiba.

2. Physiological Action.

In ordinary therapeutic doses copaiba exerts very little action on the general system. In large doses it gives rise to an increased flow of saliva, with flatulence and colic. This may be accompanied by a sensation of heat in the throat and at the pit of the stomach, loss of appetite, nausea, and purging, with violent tenesmus. It often induces irritation of the larynx, with a dry, painful cough, and the expectoration of semi-purulent greenish nauseous mucous.

It is a powerful diuretic, and is frequently employed in the treatment of Bright's disease. It imparts its characteristic odour to the urine, and on the addition of nitric acid a precipitate is formed resembling that of albumin, with the exception that it clears up on the application of heat. This precipitate consists of the oxidized oil united with some of the urinary principles. A new substance has been detected in the urine of patients taking copaiba, which has been named "copaiba-red," and has the property of reducing oxide of copper. The capaiba may be extracted from the urine by shaking it up with ether. The urine, when copaiba has been taken, does not undergo decomposition so readily as under ordinary circumstances. It remains for a longer time clear, and even when triple phosphates are ultimately deposited and the surface is covered with a film, putrefactive

bacteria are either absent or are present in small numbers. To this particular property of copaiba we are indebted for its employment in the treatment of gonorrhœa and gleet. Ordinarily the few drops of urine which remain in contact with the mucous membrane of the urethra after emptying the bladder speedily undergo decomposition, and prevent the progress towards recovery.

Copaiba produces, when taken internally, a rash on the skin, which may be an urticaria, but more commonly resembles the eruption of measles. It does not begin on the face and extend downwards over the body, but is patchy and exhibits a preference for the neighbourhood of the joints. It is not accompanied by elevation of the temperature, but is usually attended with intense itching, sore throat, diarrhœa, and vomiting.* In doubtful cases an examination of the urine will throw light on its nature.

Most ethereal oils are eliminated with the urine, but this is not the case with copaiba, the volatile oil being destroyed in the body, only the resinous acid appearing in the urine.

Copaiba is frequently adulterated with gurjun oil. Gurjun balsam, or wood-oil, is a balsamic exudation, obtained by incision and the application of heat, from the trunk of *Dipterocarpus turbinatus*, and other species, growing in the East Indies. It is a transparent liquid of the consistence of olive oil, of an opaque, dingy greenish-grey colour, as seen by reflected light, and having an aromatic odour and taste not unlike that of copaiba, but without its acridity. It sometimes produces a rash on the skin, but very rarely.† It has all the advantages of copaiba as an expectorant, without the grave disadvantage of exciting an eruption.

* Murrell, *Lancet*, 1890, vol. i. p. 568.

† *Ibid.*, p. 962.

3. Therapeutics.

The Balsam of Copaiba in doses of from ten to fifteen grains is largely employed as a diuretic in cases of ascites and in the œdema resulting from Bright's disease. The following mixture has for many years been in use at the Westminster Hospital:—

Copaiba resin	10 grs.
Rectified spirit	15 mins.
Spirits of chloroform	10 mins.
Syrup of ginger	40 mins.
Mucilage of acacia	80 mins.
Water	to 1 oz.

Some surgeons trust entirely to the internal administration of copaiba, cubebs, and oil of sandal-wood in the treatment of gonorrhœa, giving them even in the earlier stages, and to the exclusion of injections. Capsules containing copaiba, cubebs, and oil of sandal-wood, either alone or mixed in various proportions, are kept in stock by most chemists.

CUBEBS.

1. Origin.

By cubebs we mean the unripe fruit of *Piper cubeba*, a climbing plant of Java and other parts of the East Indies, where it is extensively grown in the coffee plantations. Cubebs differs from black pepper, which it closely resembles, in having a stalk some half an inch long. Its odour is strong and peculiar, and its taste is warm, aromatic, and somewhat bitter. Cubebs is a complex substance, but there is no doubt that the ethereal extract, or "oleo-resin" as it is called in the Pharmacopœia, represents its peculiar properties. This oleo-resin contains:—

1. The oil of cubebs—oleum cubebæ—a colourless or pale greenish-yellow fluid. As it is volatile, and as it is on the presence of this substance that the activity of the drug mainly depends, it is better that cubebs should not be powdered until actually required for use.

2. A resin—a brown, soft, and acrid substance—probably formed by the oxidation of the above.

3. Cubebic acid, an acid which is nearly tasteless, and forms salts with bases. The cubebate of magnesium is a convenient form for administration.

4. Cubebin, a neutral crystallizable substance, analogous to piperin obtained from black pepper. It is probably physiologically inert.

The most convenient preparation of cubebs for internal use is the tincture.

2. Physiological Action.

In small doses cubebs acts as a stimulant to the gastric mucous membrane, increases the appetite, and improves digestion, but when larger doses are taken the patient complains of a sensation of warmth at the pit of the stomach, and not unfrequently suffers from giddiness and headache. The skin is hot, and the pulse is increased in frequency. After very large doses there may be nausea, vomiting, colicky pains in the abdomen, and purging.

Cubebs is a stimulating expectorant, and is frequently smoked in the form of cigarettes by asthmatics and chronic bronchitics.

Cubebs excites an eruption on the skin, which is similar to that produced by copaiba. It is not accompanied by febrile disturbance.

Cubebs increases the secretion of urine, to which it imparts its characteristic odour. On the addition of nitric

acid a precipitate is produced, which differs from that of albumin in clearing up on the application of heat.

3. Therapeutics.

Cubebs is an excellent remedy for bronchial catarrh and chronic bronchitis. Many sufferers from the latter affection adopt the following mode of treatment. They have a cup of linseed tea made, flavoured with a slice or two of lemon, and to this is added a tea-spoonful of the tincture of cubebs. It is placed in the front of the fire to keep warm, and the mixture is slowly sipped whilst they read the paper after breakfast. It produces copious expectoration, and the patient is free from trouble for the rest of the day.

In many chronic bronchial affections, much benefit is derived from inhaling a mixture of oil of cubebs, oil of sandal-wood, and oil of lemons. The apparatus employed for this purpose is shown in the opposite figure.

It is not a bad plan to smoke cubebs for chronic bronchitis, and cubebs cigarettes have a ready sale during the winter months. In hospital practice we use dried powdered cubebs, the patient smoking it in his pipe, either alone or with a little tobacco. The smoke stimulates the mucous membrane, and the mouth is hot for some time after.

It is usually said that cubebs is useful in the early stages of gonorrhœa, and copaiba later on when it has become more matured.

COLCHICUM.

1. Origin.

Colchicum is the *Colchicum autumnale*, the common meadow saffron or naked lady, an indigenous plant which grows in moist, rich meadows and flowers in autumn. The parts which are official are the corm and the seeds.

2. Active Ingredients.

Colchicum contains colchicine, a crystalline alkaloidal principle, formerly supposed to be identical with veratrine, the active principle of savadella or cevadilla. It differs

THE ATOMIZER.

from it in having a less burning taste, in being more freely soluble in water, and in being soluble in alcohol.

[redacted]

Colchicum contains in addition cevadic acid, fatty and gummy matters, a fixed oil, and possibly traces of veratrine.

All parts of the plant are active, and it is a matter of no practical importance whether preparations of the corm or of the seeds are employed.

3. Physiological Action.

In man full doses produce repeated uncontrollable vomiting, accompanied by much retching and vomiting. Purging is common, the motions being at first serous, then mucous, and finally mixed with shreds of membrane and perhaps blood. There is a burning sensation in the stomach, and there may be griping. Muscular pains are experienced, and there is great muscular weakness, so that the sufferer is hardly able to walk. After large doses the heart becomes weak, the pulse is feeble, rapid and thready, and the skin cold, pallid, and livid. Sometimes there is an increase in the amount of urine passed, and at others it is almost suppressed. Death ensues from collapse, the brain remaining clear to the last. Colchicum exerts the same effect on the alimentary canal, whether taken by the stomach or injected subcutaneously.

By some observers it is stated that there is an increased elimination both of urea and uric acid, whilst by others this is denied. It is possible that difference in the dietary of the patients may account for this discrepancy.

In the lower animals the symptoms produced are much the same as in man. Purging, vomiting, great prostration, embarrassed respiration, and finally, more or less complete paralysis and death, preceded by convulsions. Post-mortem the blood is found to be dark in colour and imperfectly coagulated, and the mucous membrane of the intestines is swollen and intensely congested.

In frogs reflex action is lessened and finally abolished;

the motor nerves and voluntary muscles are not affected, but there is a decided action on the higher motor centres, the spinal cord and the peripheral sensory nerves. The circulation is affected, but the action is to a great extent reflex, for when the drug is injected directly into the circulation the heart and blood pressure are but slightly affected. After very large doses the inhibitory nerves of the vagus are found to be paralyzed. In its action on the stomach and intestines colchicum is allied to emetine.

It is difficult to deduce from its pharmacological action any rational explanation of the undoubted value of colchicum in the treatment of gout and its various manifestations.

4. Therapeutics.

Colchicum is a remedy of undoubted value in gout and in the gouty diathesis. The wine is, on the whole, the most satisfactory preparation. In hospital out-patient practice acute gout more commonly presents itself in the form of chiragra rather than of podagra, the explanation being that, when the feet are involved, the patient is unable to walk to the hospital. In these cases I usually prescribe half a drachm to a drachm of the vinum colchici, with ten grains of iodide of potassium in a mixture to be taken three times a day. The affected joints are painted with equal parts of extract of belladonna and glycerine, and are enveloped in cotton wool. The drachm doses of colchicum wine are reserved exclusively for able-bodied men of the brewer's drayman description. The effect is marvellously good as regards the gout, the patient usually being able to resume work on the third day; but the treatment is severe, and produces persistent purging not uncommonly accompanied by vomiting.

In less severe cases I give ten minims of the colchicum wine, with five grains of iodide of potassium in a mixture

flavoured with spirit of chloroform and syrup of orange-flower, three times a day. Even this dose often acts as a laxative, and produces a peculiar metallic taste in the mouth. Many gouty patients take this mixture at intervals all the year round, giving themselves a few days' treatment on special occasions, such as after a big dinner or an exceptional indulgence in wine. For private patients a visit to Aix-les-Bains, and a three weeks' treatment once a year under the kindly supervision of Dr. Brachet, usually works wonders.

Colchicine is a valuable remedy, and in conjunction with small doses of calomel may be prescribed with advantage for gouty people who have had no acute manifestation of the disease, but who suffer more or less continuously from joint pain. The following is a useful formula:—

Colchicine	$\frac{1}{60}$ gr.
Calomel	$\frac{1}{2}$ gr.
Extract of Hyoscyamus	to 1 gr.

This is made into a pill, and one is taken at bedtime, or three times a day after meals, according to the severity of the symptoms.

Dr. C. D. F. Phillips has furnished me with the following formula, which he has found useful in the treatment of gouty neuritis and allied affections:—

Colchicine	$\frac{1}{60}$ gr.
Sulphate of quinine	1 gr.
Extract of colocynth	1 gr.

To make a pill: one to be taken three times a day.

SQUILL.

Squill, the officinal squill or sea onion, is a very old remedy. The Egyptians worshipped it; Epimenides, who

lived in the 30th Olympiad, made much use of it; Theophrastus praised its virtues; Hippocrates used it externally, internally, and as a pessary; Pythagoras wrote a volume on it; and Dioscoroides invented the vinegar of squill. In spite of this it is now a comparatively rarely employed remedy. It is the bulb of the *Urginea scilla*, divested of its dry membranous outer scales, cut into slices and dried. Its active principle is a glucoside, scillitoxin or scillaïn, a substance which has many of the properties of digitalis.

Squill has a bitter taste, and in full doses excites nausea, vomiting, and diarrhœa, the motions being watery and often mixed with blood. It slows the pulse, raises the blood pressure, and arrests the heart in diastole. It is an expectorant, and is employed chiefly when the secretion is profuse and difficult to expel. Like digitalis it acts as a diuretic, and is reputed to be of much use in the treatment of cardiac dropsy.

It is a member of the digitalis group, and is allied in general action to adonidin, oleandrin, and apocynin.

MALE FERN.—SANTONIN.

These drugs are employed chiefly as anthelmintics. Anthelmintics are medicines which kill or cause the expulsion of intestinal worms. They are sometimes subdivided into vermicides, those which kill, and vermifuges, those which expel, the worm; but there is not much difference between the two. It is of importance to bear in mind that there are many different kinds of intestinal worms, for a drug which proves deadly to one class may be utterly inefficacious in another. Roughly speaking, there are about twenty-one different kinds of worms which are known to infest the intestinal canal. They may be divided into three classes:—

[redacted]

(1) *Flat, or Tape Worms.*—The common forms are tænia solium, the pork tape-worm, and tænia medio-canellata, the beef tape-worm. A mutton tape-worm, tænia tenella, is also described, but is not very common. These worms are as a rule single, but there may be more than one. Küchenmeister refers to numerous instances of the occurrence of several tape-worms in one host; but Cobbold states that he never met with more than four perfect tæniæ in one and the same human bearer.

(2) *Round Worms.*—The round worm, ascaris lumbricoides, inhabits the small intestine, but is fond of travelling, and frequently manages to make its way into other channels. Commonly, in this country at all events, there is only one worm; but in India, China, and Central America, scores of them are met with in the same individual.

(3) *Thread Worms, or Seat Worms.*—The common species is the oxyuris vermicularis; they inhabit the rectum, especially in children, and are usually met with in large numbers.

The drugs commonly employed as anthelmintics are:—Male fern, santonin, pomegranate root bark, kousso or cusso, kamela or wurrus, areca nut, and turpentine.

In addition to these, calomel, scammony, and various other purgatives are employed for the expulsion of thread worms, whilst injections of salt and water, perchloride of iron and water, and infusion of quassia are used as enemeta for the same purpose. When children suffer from worms it is essential, in order to prevent their recurrence, to improve the condition of the general health by the administration of such remedies as cod liver oil, extract of malt, Parrish's chemical food, and the like. Cold sponging, good feeding, and plenty of outdoor exercise are useful adjuncts.

1. Male Fern—Filix Mas.

This is the rhizome with the adherent bases of the petioles of the *Aspidium filix mas*, the common male shield fern.

The use of the male fern as a vermifuge was known to the ancients, and is referred to by Theophrastus, Dioscoroides, and Pliny. It is mentioned in Schröder's "Dispensatory" (1656), and other works published about the same time. Towards the end of the eighteenth century a Madame Nuffer, or Nuffler, the widow of a Swiss surgeon, obtained a reputation for curing tape worm by means of a specific, and in 1775 sold her "discovery" to Louis XIV. for 18,000 livres or francs. Her method consisted in the administration in the following order of (1) a panada made with bread and a little butter, (2) a clyster of salt water and olive oil, (3) the *specifique*, composed of two or three drachms of the powdered male fern in from four to six ounces of water, (4) a purgative bolus composed of calomel ten grains, scammony ten grains, and gamboge six or seven grains. The male fern was given the first thing in the morning on an empty stomach, and the purgative followed two hours later.

The active principle of male fern is filicic acid, a crystalline substance. Traces of a volatile oil, together with tannin, resin, and a little sugar, are also met with.

The only officinal preparation of the male fern is the liquid extract, commonly known as the oil of male fern. It is made with ether, and is efficacious.

The male fern is fatal to all kinds of tape worm. It is essential that it should be given on an empty stomach, as if the stomach and intestines are loaded with food it is not brought in contact with the parasite. The cure is usually effected in a single day. The patient should take nothing

but a cup of tea after his lunch or midday meal; at bedtime he is directed to take an ounce of castor oil, and in the morning half a drachm of oil of male fern made into a mixture with a drachm of mucilage of acacia, fifteen minims of syrup of ginger, and an ounce of water, to be followed in a couple of hours by another dose of castor oil. This rarely fails to expel the head and effect a cure. Cobbold gives elaborate rules for the treatment of tape worm with male fern, but if these simple directions are followed no difficulty is experienced. In overdoses aspidium acts as an intestinal irritant, and may cause death.

2. Santonin.

Santonin, or santoninum, is a crystalline principle obtained from santonica, the dried unexpanded flower heads of *Artemisia maritima*, imported from Russia. The great emporium for the worm seed is the fair at Nijni Novgorod, whence it is conveyed, *via* Moscow and Petersburg, to Western Europe. Santonin is insoluble in water, but slightly soluble in alcohol and oils. It undoubtedly represents the activity of the plant.

Santonin is employed almost exclusively for the expulsion of the round worm. It has no effect on the tape worm, and its influence on thread worms is very slight. It has a great advantage in being tasteless and odourless, so that it can be given without difficulty. There is only one pharmacopœial preparation, the lozenge, one grain of santonin in each. The dose of santonin is from two to five grains every alternate night at bedtime, followed by a purgative in the morning.

Santonin exerts a powerful action on the nervous system, and there are several cases of poisoning by it on record. After large doses patients complain of headache, lassitude, prostration, flashes of light before the eyes, hallucinations

of smell and taste, pain in the region of the stomach, nausea, vomiting, trembling of the limbs and convulsive twitchings and movements in the muscles of the face, eyes, and jaw. Administered to dogs and rabbits it gives rise to accelerated breathing, slowing of the pulse, trembling, cramps, free salivation, unconsciousness, convulsions, dilated pupils, and death.

There are two symptoms produced by santonin which are deserving of special note. The first of these is a peculiar disturbance of vision, everything appearing to the patient at first a bluish and then a yellowish or greenish yellow colour. It is technically known as xanthopsia or chromatopsia. It is due to stimulation and subsequent paralysis of the fibres of the retina by which blue light is perceived. The other symptom is the effect of the drug on the urine, which it colours bright yellow, or, if the urine is alkaline, bright red. The colour is due to some product of the oxidation of santonin.

ERGOT.

1. Origin.

Ergot is the sclerotium, compact mycelium, or spawn of *Claviceps purpurea*, a fungus growing within the palæ of the common rye, *Secale cereale*.

Amongst the lowest forms of vegetable life, and distinguished from other plants by the absence of chlorophyl, are the fungi. There are usually two stages in the life of a fungus: in the first, or vegetative period, it exists as a mycelium, a filimentous mass, the sole function of which is to grow and increase; in the second stage, the thallus, or ordinary fungus or mushroom, is formed, the function of which is to develope reproductive bodies and reproduce its

species, after which it perishes. In the case of some fungi there is an intermediate stage known as the sclerotium. The genus *Claviceps* comprises a number of parasitic fungi, which develop in the pistil of various kinds of grasses. Officinal ergot is the scleroticum of *Claviceps purpurea*, which infests the grain of *Secale cereale* or rye. Rye when attacked with the fungus is called spurred rye, "secale cornutum." The fungus makes its appearance during the early days of the pistil, and is first seen at the base as a flocculent mass—this is the mycelium. These filaments grow and invade all parts of the tissue of the pistil until they form a white mass, on which the dark sclerotium soon makes its appearance. As it grows it lifts up before it the remains of the withered and blackened pistil and casts it away, forming ergotized rye.

The etymology of the word "ergot" is doubtful. It was originally written "argot." In the dictionary of the Paris Academy ergot is given as the French word for the spur of a cock or the claws of a dog. It is probable that the drug is called ergot from its resemblance to a cockspur.

It seems hardly conceivable that so singular a product as ergot should have escaped the notice of ancient writers, but no distinct reference to it is to be found in their works on medicine. It is supposed to be the ignis sacer, or ignis sanctii Antonii, of the Middle Ages. It was employed by women to promote labour pains long before its properties were generally recognized by the medical profession. It was originally given in the crude form, an odd number of grains being administered. In the middle of the sixteenth century Loncier, of Frankfort, called attention prominently to its properties and uses. It was not until 1836 that it found a place in the London Pharmacopœia.

Ergot is imported from France, Germany, and America. It is obtained almost exclusively from rye, but the same

fungus flourishes on grasses belonging to many other genera and species. Ergot, itself, is liable to be fed on by an acarus, which often destroys the whole interior, leaving only the shell filled with the excrement of the acarus. It is advisable not to use ergot which has been kept for more than two years.

2. Active Principles.

The composition of ergot is very complex, and the active principle to which its most important action, that of causing contraction of the uterus, depends, has not been satisfactorily isolated. The following substances have at one time or another been described as active principles:—

(1) *Ergotinum, or ergotin.*—This is official, and is commonly known as Bonjean's ergotin. It is not an alkaloid or glucoside, but a purified extract of ergot. It is a dark brown extract, having the odour of roast beef. It is sometimes desiccated, and is sold in the form of brittle lumps. It is prepared with rectified spirit. There is an official solution, the injectio ergotinæ hypodermica, which consists of one part of ergotin dissolved in two parts of camphor water.

There is another substance, not official, sold under the name of Wigger's ergotin, a resinous reddish substance, which is said to possess ten times the activity of ergot. Köhler examined both varieties of ergotin, and found that Bonjean's contained all the constituents insoluble in water, whilst Wigger's contained all the soluble ones, neither of them representing all the properties of ergot.

(2) *Ergotininum, or ergotinine.*—This is a substance described by Tanret. It is a whitish alkaloid, usually amorphous, but sometimes met with in a crystalline form. It is insoluble in water, but dissolves in alcohol, ether, chloroform, and acids. It is very unstable, and decomposes

rapidly. It is best administered hypodermically in solution in lactic acid. There is reason to believe that it is physiologically inactive, and that any therapeutical action it may possess is due to the admixture of other principles.

(3) *Ecbolina, or ecbolin.*—This is a brown amorphous bitter substance, often described as an alkaloid. It is probably not a pure substance, and there is no evidence that it is active.

(4) *Ergotinic acid.*—This is a glucoside, and is probably the most active constituent of Bonjean's ergotin, and of the dialyzed ergotin of Wernich. It gives rise to ascending paralysis of the spinal cord and brain, both in frogs and mammals, with loss of voluntary motion, paralysis of the vaso-motor centre, and fall of blood pressure. It does not increase uterine contraction. It is active only when introduced hypodermically, and if administered by the stomach it is decomposed by the digestive ferments, and split up into glucose and an inert base. It is probable that it is useful as a hæmostatic.

(5) *Sclerotinic acid* is simply an impure form of ergotinic acid. It is given hypodermically, in doses of from a half to three-quarters of a grain.

(6) *Sphacelinic acid.*—This is the substance which gives rise to the gangrene of the ergot. It produces tonic contraction of the uterus.

(7) *Cornutine.*—This is an alkaloid which in pregnant animals produces clonic contraction of the uterus. Like sphacelinic acid, it can be extracted only by spirit, and is not contained in watery extracts of ergot.

In addition to these principles ergot contains about thirty-five per cent. of oil, a peculiar sugar known as mykose, and two colouring matters—scleroxanthin and sclerocrythrin.

It is probable that sphacelinic acid and cornutine are the principles which act chiefly on the uterus; but as they at present can hardly be regarded as commercial produce it is safer to use a fluid extract of ergot, such as the official ergotin.

3. Preparations.

The preparations of ergot are:—

(1) *Infusum ergotæ.*—This is an infusion prepared with boiling distilled water. It is largely employed in midwifery practice, and, sweetened with sugar, is readily taken by patients. Freshly prepared it is a reliable preparation.

(2) *Extractum ergotæ liquidum.*—This is a good preparation, and, in doses of a drachm, repeated if necessary, exerts a marked influence on the parturient uterus.

(3) *Tinctura ergotæ.*—This is made with proof spirit, and is less commonly employed than the other preparations.

(4) *Ergotinum* is made from the liquid extract with proof spirit. The hypodermic injection of ergotin, as already mentioned, is a one in three preparation.

4. Epidemics of Gangrene.

The prolonged use of ergotized bread in certain districts is reputed to give rise to epidemics of dry gangrene. This disease has seldom or never been observed in England, but was at one time common in some parts of France, where rye formed the principal food of the inhabitants. It occurred only after rainy seasons, when the grain was largely affected by ergot. Attention was first called to the subject in 1676, by M. Dodart. The patients were usually seized first in the lower extremities, and the gangrene was attended with but little fever, inflammation, or pain. The disease appeared in Switzerland in 1709

and 1716, and many people were afflicted with swellings of the feet, legs, and arms, which degenerated into a gangrene that penetrated to the bone, and ultimately resulted in the separation of the limb. Dr. Wollaston recorded several cases in one family in which gangrene was produced by partaking of damaged wheat. The mother lost her right foot at the ankle; a daughter, aged fifteen, was deprived of hers just below the knee; whilst other members of the family lost fingers and toes, besides other more or less important appendages. It is possible that the gangrene of ergot may be due to sphacelinic acid, which causes spasmodic contraction of the blood-vessels. The gangrene produced artificially in fowls is due to permanent occlusion of the smaller arteries by a hyaline substance formed during the time they are spasmodically contracted. In some cases of gangrene sclerosis has been noted in the postero-lateral columns of the cord. How far the gangrene is the result of eating ergotized bread, and how much of it is due to the absence of proper food, it is difficult to determine; ergot administered to people living under the ordinary conditions of life never produces gangrene. In a case of diabetes insipidus I gave half-drachm doses of the liquid extract every three hours for months together with marked benefit, and without the production of any symptoms of gangrene.*

5. General Action.

Administered in large doses to the lower animals, ergot induces profuse salivation, vomiting, dilatation of the pupils, hurried breathing, a frequent pulse, trembling of the limbs, a staggering gait, paraplegia, thirst, convulsions, and finally death. Administered to man the toxic action is

* *British Medical Journal*, 1875, vol. ii.

slight. Doses of an ounce of the fluid extract produce no symptoms, unless the patient happens to be pregnant.

6. Special Actions.

The chief action of ergot is exerted on involuntary muscular tissue, and the form of muscular tissue chiefly affected is that composing the uterus, especially the uterus of parturient women. It does not produce pains identical with those of labour pains, for the spasms caused by the drug are more frequent and more prolonged. In large doses it induces tetanic spasm of the whole organ. It is probable that ergot acts directly on the involuntary muscle itself, but it is conceivable that it may act in part on the uterine centre in the spinal cord. It is doubtful whether ergot ever acts as an abortefacient. Evidence shows that it aids the expulsion of the contents of the uterus when once labour has commenced, but is powerless to start the process. It is an ecbolic, but probably not an abortefacient. It has, however, the reputation of being an abortefacient, and aristocratic abortionists usually prescribe three drachms of tincture of gossipium and one ounce of liquid extract of ergot, the directions being that the patient is to take a teaspoonful in a wineglass of water three times a day.

Ergot produces spasm of the blood-vessels, acting both on the arteries and the veins. When the web of a frog's foot is placed under the microscope and ergot is injected, the vessels, both arterial and venous, are seen to undergo contraction. When the arteries of the thigh, back, or pia mater of a rabbit are exposed, and ergot is administered, there is a notable diminution in their calibre. Wave-like peristaltic spasms are often seen in the ergotized vessels so treated. The contraction of the retinal vessels can be seen with the ophthalmoscope after the administration of

ergot in man. These facts seem to show that ergot contracts the blood-vessels. Supposing this to be the case, one would expect a marked rise in blood pressure after the injection of ergot; curiously enough, however, the primary effect is to produce a marked fall in blood pressure. This is probably due to a direct action of the drug on the cardiac muscle when the injection is made into the jugular vein. As confirmatory of this theory it is asserted that the fall does not occur when the drug is introduced, not directly into the vein, but hypodermically. The ultimate effect of ergot, by whatever channel it is introduced, is to raise the blood pressure; this is undoubtedly due to a very great extent to the action of the drug on the medulla.

Ergot acts on the involuntary muscular tissue of the intestines, increasing peristaltic action. The exaggerated movement after the injection of ergot is very noticeable post-mortem, and may also be observed during life through the abdominal walls.

The quantity of urine secreted under the influence of ergot is increased in consequence of the rise of blood pressure, and there is also evidence to show that the contractile power of the bladder is intensified.

The voluntary muscles are unaffected, and the drug exerts no action on the motor nerves.

In the lower animals the spinal cord is paralyzed, and death usually ensues from paralysis of the respiratory centre.

In its action on the uterus, ergot is allied in action to gossypium, the root of the common cotton plant, and to the smut of Indian corn (*Ustilago maidis*). It is probable that the last-named substance contains some of the same active principles as ergot. In its action on involuntary muscular tissue ergot is allied to belladonna.

7. Therapeutics.

Ergot is used with success in almost all forms of bleeding, such, for example, as hæmoptysis and post-partum hæmorrhage. It must be given in large doses, and no hesitation need be felt in ordering a couple of drachms or more of good liquid extract of ergot every hour or oftener. When it is undesirable to give the medicine by mouth, the ergotine may be injected hypodermically.

Large doses of ergot are useful in subinvolution of the uterus, in cases of menorrhagia, and especially, I think, in febroid tumour.

In diabetes insipidus large doses of ergot may be given with every reasonable prospect of effecting a permanent cure.

COD LIVER OIL.

Cod liver oil, oleum morrhuæ, oleum jecoris aselli, or oleum jecoris gadi, is the oil extracted from the fresh liver of the cod, gadus morrhua. Practically, however, the oil is not infrequently derived from the liver of other species of gadus, such as the dorse, the ling, the coal fish, the pollack, and the whiting. Although we have no record fixing the exact date when cod liver oil was first used, we have reason to believe that it is a remedy of very considerable antiquity. The Greenlanders, Laplanders, and Esquimaux were acquainted with its virtues long before they came in contact with civilization.

It is chiefly to the writings of Dr. Hughes Bennett ("Treatise on the Oleum Jecoris Aselli," 1841), and of Dr. C. J. B. Williams (1849), that we are indebted for the introduction of cod liver oil into modern medicine. The oil employed by these observers was a very crude product,

and it was not until 1853 that Peter Möller introduced his method of obtaining the oil by a process of steam extraction.

Cod liver oil is procured from Norway and Newfoundland. In Norway most of the codfish are taken in the neighbourhood of the Lofoten islands, within the arctic circle, the annual yield being somewhere about 24,500,000 fish. Amongst cod liver oil-producing countries Norway naturally takes the first place. This is due to the fact that the Norwegian fisheries are carried on under circumstances much more favourable than are met with elsewhere. The steam process of extraction requires a supply of absolutely fresh livers, and the fishing grounds of Lofoten and Romsdalen are situated so near the coast that the boats leaving in the morning are back again with their catch of fish in the course of a few hours. Off the banks of Newfoundland fleets of smacks are employed collecting the fish, which are taken to an attendant steamer, where the process of extraction is carried on.

There are three different and distinct processes by which the oil may be extracted:—

1. The livers are packed in high vats, furnished with three sets of taps at different heights, and exposed freely to the rays of the sun. The highest tap yields a pale oil free from impurities; from the middle tap is obtained a light brown oil, whilst the bottom tap furnishes a dark brown oil. The remaining mass of the livers yields, by heat and pressure, an oil which is unsuited for medical purposes.

2. The second method of preparing the oil is by boiling the livers in water, and then skimming off the oil from the surface. It is filtered to free it from albumin, cellular tissue, and other impurities.

3. The third method is the best and yields the purest oil. The livers are collected daily so that they are always

perfectly fresh, and they are carefully examined so as to remove all traces of blood and other foreign bodies. They are then sliced and exposed to a temperature of 180° F., till all the oil has drained away from them. The oil so obtained is filtered, and exposed to a temperature of 50° F., to coagulate the solid fat, after which the oil is again filtered, and then run into bottles carefully corked to exclude the access of air. This method, which is known as the "steam process," was introduced by Peter Möller, and the great difference between it and the older methods is that the oil pure and simple is extracted from the livers instead of the oil mixed with a great number of decomposition products. In order that this process may be carried out with due regard to its essential principle, it is necessary that the livers should be absolutely fresh. If over twelve hours are allowed to elapse after the capture of the fish, first-rate oil cannot be procured from their livers.

There is no test for the purity of cod liver oil. Leaving adulteration out of the question, and assuming a genuine specimen of oil from gadus morrhua, the only criteria on which reliance can be placed are colour, taste, and smell.

The only form of cod liver oil rendered official is the "light" oil. It is defined as a pale yellow oil with a slight fishy odour, and bland fishy taste. The best kinds of cod liver oil are as nearly as possible colourless and tasteless. Some people prefer the coarse brown oil, but they are decidedly in the minority, and practically it is found that the paler the oil the better it is adapted for medicinal purposes. The darker varieties have the same composition, but they contain more empyrematic matter, and are less agreeable to the taste. Nowadays no one even thinks of prescribing the brown oil. It is simply an abomination, and it is almost inconceivable that any patient could be found willing to take it. Some people seem to delight in

nasty medicines, but there is no advantage in taking this nauseous compound.

Cod liver oil is a food rather than a medicine, and much of its utility is due to its ready absorption and quick assimilation.

That cod liver oil is more readily absorbed than olive oil can be demonstrated by a very simple experiment. If two loops of intestines are filled, one with cod liver oil and the other with olive oil, and then replaced, the one containing cod liver oil soon becomes less distended than the other.

Cod liver oil is easily digested, because a portion of the fat is in the form of fatty acids. When these reach the intestines they become at once saponified without the coöperation of the pancreatic ferment, and they emulsify the remaining fat and favour its absorption.

That cod liver oil is readily absorbed may be demonstrated by a very simple experiment. In capillary tubes moistened with water fats rise very little, but when the tubes are moistened with bile the fats rise readily.

Fats pass with difficulty through moist animal membranes, but if the membrane is moistened with bile they pass through readily.

Cod liver oil is not absorbed by the stomach, but promotes the conversion of starch into sugar. After absorption from the intestines the chief portion of the fat passes into the lacteals, and a little into the veins to be conveyed to the liver, there to be converted into cholic acid. The cholic acid uniting with the soda set free when the hydrochloric acid of the gastric juice is poured into the intestines, forms a kind of soap, consisting of taurochlorate and glycocholate of glycerine. These again find their way into the intestines, where the base unites with the acid of the gastric juice from which it has been separated. The influence of cod liver oil on the secretion of the bile

varies according to circumstances, for if taken on an empty stomach it lessens biliary secretion, whilst if taken with or after food it increases it.

Cod liver oil after passing into the blood-vessels influences the nutrition of the blood corpuscles, contributing to their formation and development. It is found that in health cod liver oil causes a decided increase in the number of blood corpuscles, and also a slight increase in the number of white ones. In virtue of its property of stimulating nutrition, cod liver oil improves all the functions of the body, although it has no specific action on any of the organs themselves.

There seems to be very little doubt that animal fats such as cod liver oil exert a much more powerful influence on the system than do vegetable fats, and the superiority of the fat obtained from the liver is supposed to be due to their more ready absorption. Whether the fat obtained from the liver of the cod possesses any particular advantage over fats derived from the liver of other animals may be open to question.

Cod liver oil is not absorbed in unlimited quantities, and if given in excessive doses produces nausea and diarrhœa, and is eliminated with the fæces. As a rule, fats are consumed in the body, the quantity eliminated, either with the fæces or the urine, being very small.

Cod liver oil is of such inestimable value, not only in phthisis but in all wasting diseases, and it is so universally employed, that a mere reference to its use as a fattening agent is all that is necessary.

Cod liver oil is useful in the chronic diseases of children arising from mal-nutrition in the various manifestations of scrofula.

It is just as useful for old people as it is for children.

The points in the administration of cod liver oil as a therapeutic agent are:—

[redacted]

1. That the oil should be of pale colour and practically tasteless and odourless.

2. That the initial dose should be a tea-spoonful, and that the maximum dose should not exceed a table-spoonful.

3. That it should be given immediately after food, so as to form practically a portion of the meal.

The oil may be given by itself; with a pinch of salt; floating on a glass of frothed up stout; or floating on the top of a mixture such as the gentian and soda mixture. The following prescriptions for "oil sauce," designed by the late C. J. B. Williams, are well known:—

(1)	Dilute phosphoric acid	½ oz.
	Solution of strychnine	1 dr.
	Tincture of orange-peel	1 oz.
	Syrup of ginger	1 oz.
	Compound infusion of orange-peel	...to 8 ozs.

The dose is one table-spoonful.

(2)	Dilute phosphoric acid	½ oz.
	Hypophosphite of sodium	2 drs.
	Tincture of quinine	1½ oz.
	Glycerine	1 oz.
	Compound infusion of orange ...	...to 8 oz.

Dose, one table-spoonful.

(3)	Dilute nitric acid	3 drs.
	Tincture of calumba	1 oz.
	Syrup of ginger	1 oz.
	Compound infusion of orange ...	...to 8 ozs.

Dose, one table-spoonful.

On theoretical grounds the custom of giving cod liver oil with an acid mixture is open to criticism.

Cod liver oil is sometimes given in the form of an emulsion, but these preparations are, as a rule, not palatable, and have no advantage over the pure drug. The substances

commonly employed as emulsifying agents are eggs, dextrine, extract of malt, quillaia, condensed milk, and various gums. A fairly good emulsion may be made by rubbing up together cod liver oil, the yolk of egg, powdered tragacanth, elixir of saccharine, spirit of chloroform, essential oil of almonds, and water. The success of the emulsion depends less on the proportions of the ingredients than on the amount of time devoted to amalgamating them.

In connection with the use of cod liver oil as a fattening agent it is of interest to note that in many parts of America castor oil in half-ounce or ounce doses is largely used for this purpose. It is quite true that for the first week or ten days it purges freely, but tolerance is soon established and phthisical patients rapidly gain flesh. In Egypt, castor oil is commonly used as a salad dressing, and after a few days it rarely produces any inconvenience.

CANTHARIDES.

1. Origin.

The Cantharis vesicatoria, Lytta vesicatoria, blister beetle or Spanish fly, is indigenous to Southern and Central Europe, and is collected in Russia and Sicily, but chiefly in Hungary. The "flies" are sometimes met with in England, but very rarely. During the months of May and June they swarm on the ash, privet, lilac, and elder. They are collected usually in the early morning, or in the evening, when they are drowsy, by spreading cloths under the trees, which are then shaken or beaten with long poles. The beaters wear masks, and their hands are protected with gloves. The insects are killed by dipping them for a moment in boiling vinegar, after which they are dried on hurdles covered with sheets of paper. They are preserved in well-stoppered

bottles, and a few drops of strong acetic acid are usually added to prevent the ravages of mites which attack them freely. The beetles have a peculiar urinous odour, and a hot, burning taste. Their appearance is so well known that it is needless to describe them. The finely powdered cantharides is of a greyish brown colour, mixed with minute shining green particles—the fragments of the elytra or wing cases.

2. Active Principle.

The active principle of cantharides is a crystalline substance known as cantharidin. It is usually in flat, glistening rectangular prisms. It is soluble in glacial acetic acid, in chloroform, and in oils, but is insoluble in water, and only very slightly soluble in cold alcohol.

3. Preparations.

There are seven preparations of cantharides. The acetum or vinegar contains glacial acetic acid, which is one of the best solvents for cantharidin. The linimentum cantharidis, also known as liquor epispasticus or blistering fluid, is made with acetic ether. There are two plasters, the emplastrum cantharidis or cantharides plaster, and the emplastrum calefaciens, the warm or warming plaster. There are two other preparations for external use, the ointment and the charta epispastica or blistering paper. The tincture is the only preparation given internally.

4. Physiological Action.

Preparations of cantharides applied to the surface of the skin produce rubefacient and irritant effects, followed by vesication. When strong preparations, such as the liquor, are employed they excite in a variable time, depending on the strength of the application, tingling, smarting, and a

sense of heat, the papillæ becoming reddened and elongated, and on these papular elevations minute vesicles are formed, which gradually enlarge, and by lateral extension coalesce, so as to form blebs of various sizes filled with an albuminous fluid. When the application is prolonged suppuration, ulceration, and even sloughing may ensue. The effects of cantharides differ from those of mustard chiefly in being less rapid but more severe.

The tincture of cantharides taken internally produces an unpleasant burning taste in the mouth, and may give rise to inflammation and vesication of the mucous membrane. The effect on the œsophagus and stomach is similar. Inflammation is excited, and the patient suffers from diarrhœa and vomiting. There is difficulty in swallowing, and the stools and vomited matter are mixed with blood and mucus. Peritonitis is excited, the temperature is elevated, and the pulse quickened. From the stomach the active principle is absorbed into the blood, and in the process of elimination gives rise to irritation of the urinary passages and organs of generation. The most noticeable symptoms are pain in the loins, a burning sensation referred to the bladder and urethra, irritation of the glans, penis, and sexual excitement. The patient suffers from painful and persistent erections, difficulty of micturition, or suppression of the urine. The urine contains albumin, and not infrequently blood. The inflammation produced by cantharides begins in the glomeruli, and not in the straight tubes. The first condition of the kidneys noticed after the administration of cantharides is extravasation of leucocytes into the glomeruli, and an exudation of a fibrous matrix. This is followed by filling of the glomeruli and the proximate tubules with a granular fluid, after which comes swelling of the cells of the capsule. Next in order, swelling of the cells of the collecting tubes and of the whole urinary tubule is observed; and in the last

stage, multiplication of the cells of the straight collecting tubes which are thrown off, so that the lumen becomes filled with exuded cells.

When the kidneys are affected cantharides must be employed cautiously, or it may not be eliminated by those organs. In young people, and those debilitated by disease, it should be used as a vesicant with the greatest caution, as from the low vitality of the tissues it is apt to produce sloughing and gangrene. The contraction of distant capillaries is not infrequently followed by a paretic distension and lowering of trophic change, analogous to the condition which gives rise to the occurrence of duodenal ulcer after severe burns of the surface.

5. Therapeutics.

Preparations of cantharides are largely employed as local applications for promoting the growth of the hair. The following is a useful lotion:—

Tincture of cantharides	6 drs.
Tincture of nux-vomica	3 drs.
Distilled vinegar	2½ ozs.
Tincture of capsicum	1 dr.
Spirit of rosemary	2 drs.
Elder flower water	1 oz.
Rose water	to 6 ozs.

Large doses of cantharides are useful in impotence, especially in the impotence of elderly men. The following prescription usually exercises a beneficial effect:—

Tincture of cantharides	2½ drs.
Tincture of perchloride of iron	2 drs.
Tincture of nux-vomica	1½ drs.
Dilute phosphoric acid	½ oz.
Glycerine	3 drs.
Elixir of orange	1 oz.
Water	to 8 ozs.

An eighth part to be taken three times a day after meals.

It is undoubtedly useful, but accessory treatment will be found useful.

Some people in these cases place more reliance on a pill containing two grains of extract of damiana, a quarter of a grain of nux-vomica, and a hundredth of a grain of phosphorus, but the mixture rarely fails.

As a local application a lotion containing half a drachm of tincture of cantharides in six ounces of water, scented with eau de Cologne or elder flower water, is frequently recommended by irregular practitioners.

Small doses of cantharides may be relied on to cure the slight incontinence of urine which in women is frequently associated with paroxysmal cough. Half a drachm of tincture of cantharides is prescribed with four ounces of water, and of this a tea-spoonful is taken hourly. It rarely fails to effect a cure in twenty-four hours.

Externally cantharides is of the greatest value in the form of "flying blisters." Half a dozen pieces of emplastrum cantharides the size of half a crown should be applied to the chest and back in cases of pleurisy and pleurodynia, taking care to remove them to some other part before they produce vesication. This mode of treatment acts as a powerful stimulant in cases of fever in which a typhoidal condition is the chief danger.

When larger blisters are applied, and a bleb is formed, it is better to cover it with cotton wool and allow the serum to be absorbed rather than to cut it and evacuate the fluid.

Blistering fluid is a very uncertain preparation, and even when the skin has been previously poulticed, or fomented, it often fails to raise a blister.

SYNOPSIS

OF

PHARMACOLOGICAL ACTIONS.

PHARMACOLOGICAL GROUPS.

1. Exhilarants.

Alcohol.
Ether.
Chloroform.
Tea.
Coffee—Caffeine.
Coca—Cocaine.
Opium (small doses).

2. Deliriants.

Cannabis indica—Cannabin.

Belladonna—Atropine—Homatropine.
Hyoscyamus—Hyoscyamine.
Stramonium.

Alcohol.
Ether.
Chloroform.
Turpentine.
Nitrous Oxide Gas.

3. Hypnotics or Soporifics.

Opium.
  Morphine.
  Codeine.

Chloral Hydrate.

Paraldehyde.
Butyl-chloral-hydride.

Sulphonal.

Alcohol.

4. Cerebral Sedatives.

Bromides.
Hop.
Beer.

Lettuce.
Alcohol.
  (Brandy-and-water hot).

5. General Anæsthetics.

Chloroform.
Ether.
Nitrous Oxide Gas.

Tetrachloride of carbon.
Ethidene.
"A. C. E." mixture.

6. Local Anæsthetics.

Ether.
Ice.
Cocaine.
Aconitine.

Carbolic acid.
Menthol.
Thymol.
Volatile oils.

7. Spinal Stimulants.

Nux-vomica.
  Strychnine.
  Brucine.

Ignatia.

Thebaine.

Cannabis indica.

8. Spinal Sedatives.

Bromides.
Chloral hydrate.
Paraldehyde.

Butyl-chloral hydrate.
Physostigma.
  Physostigmine.

9. Cerebral Convulsants.

Picrotoxin.
Camphor.

10. Paralysers of Motor Nerves.

Curare.
  Curarine.
Conium.
  Coniine.

Ethyl-strychnine.
Methyl-strychnine.
Methyl-atropine.
Ethyl-nicotine.
Methyl-nicotine.

Many other substitution compounds of alkaloids have this action.

11. Diaphoretics.

Jaborandi.
  Pilocarpine.
Muscarine.
Picrotoxin.

Acetate of ammonium.
Dover's powder.

Alcohol.
Ether.

12. Anhydrotics.

Belladonna.
  Atropine.
  Homatropine.
Hyoscyamus.
  Hyoscyamine.
Stramonium.

Jaborine.

Pilocarpine (small doses).
Dover's powder ,,
Picrotoxin. ,,

Agaricus.
  Agaricine.

13. Mydriatics.

Belladonna.
  Atropine.
  Homatropine.

Hyoscyamus.
  Hyoscyamine.
Cocaine.

Gelsemine.

14. Myotics.

Physostigmine.
Pilocarpine.

Opium.
Morphine.

Cocaine is used as an anæsthetic for the eye, and when dilatation of the pupil is objectionable, it is used in conjunction with eserine.

15. Cardiac Tonics.

Digitalis.
Digitalin.
Digitalein.
Digitoxin.
Strophanthus.
Strophanthin.
Convallaria.
Convallamarin.
Casca.
Erythrophlœin.
Adonis.
Adonidin.

16. Cardiac Stimulants.

Ammonia.
Brandy.
Whisky.
Champagne.
Eau de Cologne.
Ether.
Spirit of chloroform.

17. Cardiac Depressants.

Aconite.
Veratrum viride.
Tobacco.

18. Vascular Dilators.

Nitroglycerine.
Nitrite of amyl.
Nitrous ether.
Alcohol.
Ether.

19. Vascular Contractors.

Belladonna.
Ergot.
Digitalis.

20. PULMONARY STIMULANTS.

Apomorphine (by mouth).	Chloride of ammonium.
Ipecacuanha.	Iodide of potassium.
Antimonial wine.	Tar.
Carbonate of ammonium.	Turpentine.

Pure terebene.

21. PULMONARY SEDATIVES.

Conium.	Hyoscyamus.
Coniine.	Stramonium.
Belladonna.	Tobacco.

Hydrocyanic acid.

22. SPECIAL RESPIRATORY STIMULANTS.

(Acting on the nerve centres which preside over respiratory movements.)

Atropine.
Strychnine.
Cocaine.

23. SALIVATORS.

Jaborandi.	Picrotoxin.
Pilocarpine.	
Muscarine.	Mercury.

24. MOUTH DRYERS.

Belladonna.	Hyoscyamus.
Atropine.	Hyoscyamine.
Homatropine.	Stramonium.

Jaborine.

25. Stomachic Tonics.

Quinine.

Gentian.
Calumba.
Quassia.

Chiretta.
Cusparia.

Nux vomica.
  Strychnine.

26. Diminishers of Secretion.

Acids.
Opium.
Belladonna.

27. Emetics.

Apomorphine (hypodermically).
Sulphate of zinc.
Ipecacuanha.
Mustard.

Tartrated antimony.
Sulphate of copper.
Common salt.
Mustard.

28. Stomachic Sedatives.

Bismuth.
Hydrocyanic acid.
Oxalate of cerium.
Opium.

29. Purgatives.

Sulphur.
Tamarinds.
Figs.
Honey.
Manna.
Castor oil.
Senna.

Magnesia.
Saline purgatives.

Aloes.
  Aloïn.
Colocynth.
Scammony.
Jalap.
Blue pill.
Elaterium.
  Elaterin.
Croton oil.

30. Cholagogues.

Blue pill.
Podophyllin.
Enonymin.

Iridin.
Hydrastis.
  Hydrastin.

31. Anthelmintics.

Filix mas.
Santonica.
  Santonin.
Pomegranate root.

Kamela.
Kousso.
Areca nut.

Infusion of quassia (enema).
Tincture of perchloride of iron (enema).
Salt and water (enema).

Turpentine.

32. Diuretics.

Digitalis.	Juniper.
Strophanthus.	Alcohol—Gin.
Broom tops.	Potash salts.
Caffeine.	Acetate of ammonium.
Copaiba.	

33. Producers of Hæmaturia and Albuminuria.

Cantharides.
Turpentine.
Carbolic acid.

34. Producers of Glycosuria.

Nitrite of amyl.
Ether.
Chloroform.
Carbonic oxide.
Morphine (large doses).

35. Vesical and Urethral Alteratives.

Copaiba.	Benzoin.
Cubebs.	Eucalyptus.
Sandal-wood.	Pure terebene.

Santonin, rhubarb, carbolic acid, and resorcin colour the urine, whilst turpentine, eucalyptus, and pure terebene give it a characteristic odour.

36. Aphrodisiacs.

Nux-vomica.
  Strychnine.
Cantharides.
Phosphorus.
Tincture of perchloride
  of iron (large doses).
Damiana.

37. Anaphrodisiacs.

Bromides.
Tobacco (?).

38. Emmenagogues.

Permanganate of potassium.
Binoxide of manganese.
Borax.
Senecio.
  Senecin.

Ergot.

39. Ecbolics.

Ergot.
Ustilago.
Cotton-seed oil.

Savin.

40. Abortifacients (?).

Ergot.
  Ergotin.
Cotton-seed oil.
Savin.
Pennyroyal.
Bitter apple.
Parsley.
  Apiol.
Green tea.

[redacted]

WEIGHTS AND MEASURES.

WEIGHTS AND MEASURES.

The original standard of weight was a natural object—a grain of wheat. In the reign of Henry III. it was decreed that the English silver penny should weigh thirty-two grains of wheat, well dried and selected from the middle of the ear.

The following was the TROY or APOTHECARIES weight:—

Pound.		Ounces.		Drachms.		Scruples.		Grains.
1	=	12	=	96	=	288	=	5760
		1	=	8	=	24	=	480
				1	=	3	=	60
						1	=	20

This has been abolished for weighing drugs, and AVOIRDUPOIS WEIGHT has been substituted, which is as follows:—

Pound.		Ounces.		Grains.
1	=	16	=	7000
		1	=	437·5

Or, putting it in another way—

1 grain				
1 ounce	=	437·5 grains		
1 pound	=	16 ounces	=	7000 grains

The drachm, although not officially recognized for weights, is used as the equivalent of sixty grains; the term scruple is sometimes used as the equivalent of twenty grains.

For measuring medicines we employed IMPERIAL MEASURE, which is as follows:—

Gallon.		Pints.		Fluid ounces.		Fluid drachms.		Minims.
1	=	8	=	160	=	1280	=	76800
		1	=	20	=	160	=	9600
				1	=	8	=	480
						1	=	60

A pint of distilled water, at 15·6° C. (60° F.) weighs 7291·2 grains, and the fluid ounce under the same circumstances 455·7 grains.

A gallon weighs 10 lbs. of water.

A drop is supposed to be equivalent to a minim, but this is only a rough calculation, and is by no means correct in all cases.

Approximately,

A tea-cup holds	4 fluid ounces.
A sherry-glass	2 fluid ounces.
A table-spoonful	4 fluid drachms.
A dessert-spoonful	2 fluid drachms.
A tea-spoonful	1 fluid drachm.

These statements are all more or less incorrect. Of late years our spoons have little by little been getting bigger and bigger, so that the fluid drachm is represented by an egg-spoonful, whilst the tea-spoon usually holds from two to three fluid drachms.

To attain anything like accuracy in measuring fluids, a measure-glass, marked in ounces and drachms, should be employed, or, better still, little porcelain cups, which, when filled to the inner brim, hold the exact quantity.

A gill is supposed to be four ounces.

On the Continent, fluid drugs are weighed, and not

measured; the bottle is put on one scale and counter-balanced with shot, and the liquid is then poured into the bottle until it turns the scale against the weight in the other pan.

The relation of measures to weights is shown in the following table:—

1 Minim is the measure of		0·91	grs.	of water
1 Fluid drachm	,, ,,	54·68	,,	,,
1 Fuid ounce	,, ,,	1 oz., or 437·5	,,	,,
1 Pint	,,	1·25 pounds, or 8750	,,	,,
1 Gallon	,,	10 pounds or 70,000	,,	,,

English weights and measures are difficult to understand, and few people succeed in mastering them.

The Metric System was introduced by the Prince de Talleyrand, Bishop of Autun in 1790, and has been so generally accepted that, at the present day, it is recognized by practically all civilized nations.

The starting-point of the metric system is the metre, the unit of length, which is $\frac{1}{40,000,000}$ part of the circumference of the earth at the poles.

From this we get the unit of capacity, the litre, which is the cube of $\frac{1}{10}$ of a metre. From this we get the unit of weight, the gramme, which is the weight of the quantity of water at its maximum density, 4° C. (39·2° F.), which will fill the cube of $\frac{1}{100}$ part of a metre.

The system is known as the Metric, or Metrical System, because each unit is derived from the metre, and also as the decimal system, because in obtaining the multiples and sub-divisions the number ten is alone employed.

The prefixes indicating multiplication are of Greek origin; whilst those indicating sub-division are of Latin origin.

It has been suggested that the prefix of the multiples

should be written with a capital letter, and the prefix of the fractional parts with a small letter.

The following memoria technica has been suggested for remembering the simple fact that,

G	I	L	D
reek	ncreases	atin	ecreases.

A kilogramme	is	1000 grammes.
A hectogramme	„	100 grammes.
A dekagramme	„	10 grammes.
A decigramme	„	$\frac{1}{10}$ of a gramme.
A centigramme	„	$\frac{1}{100}$ of a gramme.
A milligramme	„	$\frac{1}{1000}$ of a gramme.

The weights in common use are the kilogramme, gramme, centigramme, and milligramme. The kilogramme is often spoken of familiarly as a "kilo."

A gramme is 15·432 grains.

A litre is 2·113 pints.

A metre is 3 ft., 3 ins. and three-eighths, or 39·370 inches.

To convert

Grammes into grains,	multiply	by		15·432.
Centigrammes	„	„	„	0·15432.
Milligrammes	„	„	„	0·01543.

To convert

Kilogrammes into avoirdupois ounces,	multiply	by	35·2739.
Grammes	„	„	„ 0·3527.

To convert

Kilogrammes into avoirdupois pounds, multiply by 2·2046.

To convert

Grains into grammes,	multiply by	0·0648.
„ centigrammes	„	6·4799.

To convert
Avoirdupois ounces into grammes, multiply by 28·3495.
" " " kilogrammes " 0·02835.
" pounds " " " 0·4536.

To convert
Fluid ounces into cubic centimetres, multiply by 29·570.
Pints " litres " " 0·4731.
Imperial pints " " " " 0·5676.

The following tables will be found of use :—

EQUIVALENTS OF AVOIRDUPOIS AND METRIC WEIGHT.

Avoir. ounces.		Grammes.	Avoir. pounds.		Grammes.
$\frac{1}{16}$	=	1·7723	1	=	453·60
$\frac{1}{8}$	=	3·5447	2	=	907·18
$\frac{1}{4}$	=	7·08814	2·2	=	1000·00
$\frac{1}{2}$	=	14·175	3	=	1360·78
1	=	28·350	4	=	1814·37
2	=	56·700	5	=	2267·96
3	=	85·050	6	=	2721·55
4	=	113·400	7	=	3175·14
5	=	141·75	8	=	3628·74
6	=	170·10	9	=	4082·33
7	=	198·45	10	=	4535·92
8	=	226·80			
9	=	255·15			
10	=	283·50			

Equivalents of Metric and Avoirdupois Weight.

Grammes.		Ozs.	Grs.	Grammes.		Ozs.	Grs.
28·31	=	1		70	=	2	205
29	=	1	10	80	=	2	360
30	=	1	25	85	=	3	
31	=	1	41	90	=	3	76
32	=	1	56	100	=	3	230
33	=	1	72	125	=	4	179
34	=	1	87	150	=	5	127
35	=	1	103	200	=	7	24
36	=	1	118	300	=	10	255
37	=	1	113	400	=	14	48
38	=	1	149	500	=	17	279
39	=	1	164	600	=	21	72
40	=	1	180	700	=	24	303
50	=	1	334	800	=	28	96
60	=	2	50	900	=	31	326
				1000	=	35	120

[redacted]

PRESCRIPTIONS.

PRESCRIPTIONS.

I.—MIXTURES.

1. Gentian and Soda Mixture.

Bicarbonate of sodium, fifteen grains.
Spirit of chloroform, fifteen minims.
Tincture of capsicum, one minim.
Syrup of orange, half a drachm.
Compound tincture of gentian, half a drachm.
Compound infusion of gentian, to an ounce.

To be taken three times a day, before meals.

2. Calumba and Acid Mixture.

Dilute hydrochloric acid, ten minims.
Tincture of nux-vomica, five minims.
Glycerine, fifteen minims.
Tincture of calumba, a drachm.
Infusion of calumba, to an ounce.

To be taken three times a day, after meals.

3. Quinine Mixture.

Sulphate of quinine, two grains.
Dilute sulphuric acid, two minims.
Tincture of orange, one drachm.
Water, to an ounce.

To be taken three times a day, before meals.

4. Strong Quinine Mixture.

Sulphate of quinine, five grains.
Dilute sulphuric acid, five minims.
Tincture of gelsemium, ten minims.
Spirit of chloroform, fifteen minims.
Cinnamon water, to an ounce.

Useful in supra-orbital neuralgia.

5. Perchloride of Iron Mixture.

Tincture of perchloride of iron, fifteen minims.
Spirit of chloroform, fifteen minims.
Glycerine, fifteen minims.
Water, to an ounce.

Three times a day, after meals.

6. Aperient Iron Mixture.

Sulphate of iron, two grains.
Sulphate of magnesium, half a drachm.
Dilute of sulphuric acid, five minims.
Tincture of capsicum, two minims.
Peppermint water, to an ounce.

Three times a day, after meals.

7. Saline Iron Mixture.

Citrate of potassium, half a drachm.
Tincture of perchloride of iron, fifteen minims.
Spirit of chloroform, fifteen minims.
Water, to an ounce.

Three times a day, after meals.

8. Acetate of Ammonium and Iron Mixture.

Solution of acetate of ammonium, two drachms.
Tincture of perchloride of iron, ten minims.
Spirit of ether, ten minims.
Dilute acetic acid, ten minims.
Water, to an ounce.

9. Effervescing Iron Mixture, No. 1.

Citrate of iron and ammonium, ten grains.
Carbonate of ammonium, five grains.
Bicarbonate of potassium, fifteen grains.
Syrup of ginger, half a drachm.
Water, to an ounce and a half.

To be taken with a table-spoonful of lemon juice during effervescence.

10. Effervescing Iron Mixture, No. 2.

Citrate of iron and quinine, ten grains.
Sulphate of quinine, two grains.
Citric acid, seventeen grains.
Water, to an ounce.

To be taken three times a day during effervescence, with

Bicarbonate of sodium, twenty grains.
Water, half an ounce.

11. Effervescing Iron Mixture, No. 3.

Citrate of iron and quinine, ten grains.
Citric acid, seventeen grains.
Water, to half an ounce.

To be taken during effervescence, with

Bicarbonate of potassium, twenty-five grains.
Spirit of chloroform, fifteen minims.
Water, to an ounce.

12. Quinine and Iron Mixture.

Sulphate of quinine, two grains.
Sulphate of iron, three grains.
Dilute sulphuric acid, two minims.
Tincture of capsicum, one minim.
Chloroform water, to an ounce.

Three times a day, after meals.

13. Iron and Digitalis Mixture.

Tincture of perchloride of iron, fifteen minims.
Infusion of digitalis, one drachm.
Dilute phosphoric acid, fifteen minims.
Water, to an ounce.

Three times a day, after meals.

14. Bromide of Potassium Mixture.

Bromide of potassium, twenty grains.
Spirit of chloroform, fifteen minims.
Syrup of orange-flowers, half a drachm.
Water, to an ounce.

Three times a day, after meals, with an extra dose at bedtime.

15. Iodide of Potassium Mixture.

Iodide of potassium, five grains.
Tincture of Virginian prune, half a drachm.
Chloroform water, to an ounce.

Three times a day, after meals.

16. Iodide of Sodium Mixture.

Iodide of sodium, fifteen grains.
Water, half an ounce.

To be taken in a cup of black coffee, after dinner, in cases of asthma.

17. Diuretic Mixture, No. 1.

Acid tartrate of potassium, forty grains.
Tincture of digitalis, ten minims.
Spirit of nitrous ether, half a drachm.
Water, to an ounce.

18. Diuretic Mixture, No. 2.

Acetate of potassium, two grains.
Tincture of strophanthus, ten minims.
Compound spirit of ether, fifteen minims.
Spirit of juniper, fifteen minims.
Decoction of broom, to an ounce.
Three times a day, after meals.

19. Expectorant Mixture, No. 1.

Carbonate of ammonium, five grains.
Ipecacuanha wine, ten minims.
Spirit of chloroform, fifteen minims.
Compound spirit of ether, ten minims.
Syrup of tar, two drachms.
Syrup of Virginian prune, half a drachm.
Water, to an ounce.

20. Expectorant Mixture, No. 2.

Chloride of ammonium, ten grains.
Carbonate of ammonium, five grains.
Iodide of potassium, three grains.
Spirit of ether, fifteen minims.
Liquid extract of liquorice, one drachm.
Water, to an ounce.
To be taken every four hours.

21. Apomorphine Mixture.

Solution of amorphine, ten minims.
Dilute nitro-hydrochloric acid, five minims.
Tincture of Virginian prune, twenty minims.
Syrup of Virginian prune, twenty minims.
Water, to an ounce.

May be taken three times a day, as an expectorant.

22. Acetate of Lead Mixture.

Acetate of lead, five grains.
Solution of acetate of morphine, ten minims.
Dilute acetic acid, fifteen minims.
Cinnamon water, to an ounce.

23. Gallic Acid Mixture.

Gallic acid, ten grains.
Dilute sulphuric acid, ten minims.
Tincture of capsicum, one minim.
Acid infusion of roses, to an ounce.

24. Turpentine Mixture.

Oil of turpentine, fifteen minims.
Mucilage of acacia, one drachm.
Spirit of lavender, half a drachm.
Pimento water, to an ounce.

25. Colchicum Mixture.

Colchicum wine, fifteen minims.
Iodide of sodium, five grains.
Spirit of chloroform, fifteen minims.
Compound spirit of ether, five minims.
Syrup of orange flower, half a drachm.
Water, to an ounce.

Taken three times a day, is useful in chronic gout.

26. Senecio Mixture.

Tincture of senecio, half a drachm.
Syrup of lemons, fifteen minims.
Spirit of chloroform, ten minims.
Water, to an ounce.

For amenorrhœa; to be taken four times a day.

27. Amber Mixture.

Oil of amber, ten minims.
Powdered gum acacia, one drachm.
Syrup of orange flower, two drachms.
Oil of anise, three minims.
Water, to an ounce.

Useful in chronic bronchitis, and also in whooping cough.

28. Terpene Mixture.

Terpene hydrate, ten grains.
Simple elixir, one drachm.
Water, to an ounce.

Messrs. Jabez Monro & Co., of 273, Regent Street, London, make a very useful elixir of terpene, containing ten grains of terpene hydrate to the drachm. Terpene is so largely used in France in the treatment of bronchial catarrh, that it is somewhat surprising that it is not more generally employed in this country. For diabetic patients the elixir is sweetened with saccharine in place of sugar.

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II.—DRAUGHTS.

1. Sedative Draught.

Bromide of potassium, fifteen grains.
Bromide of sodium, fifteen grains.
Syrup of chloral, one drachm.
Syrup of tolu, one drachm.
Water, to an ounce.

The draught to be taken at bedtime for sleeplessness.

2. "Pick-Me-Up."

Bromide of potassium, fifteen grains.
Spirit of chloroform, twenty minims.
Compound tincture of gentian, ten minims.
Compound tincture of cardomoms, ten minims.
Aromatic spirits of ammonia, ten minims.
Simple elixir, half a drachm.
Peppermint water, to an ounce.

3. Exalgine Draught, No. 1.

Exalgine, four grains.
Essence of peppermint, five minims.
Syrup of orange flower, half a drachm.
Linden water, to an ounce.

For the relief of neuralgia.

4. Exalgine Draught, No. 2.

Exalgine, four grains.
Tincture of Virginian prune, twenty minims.
Glycerine, fifteen minims.
Water, to an ounce.

5. Antipyrin Draught.

Phenazone, five grains.
Elixir of orange, one drachm.
Water, to an ounce.

For headache.

6. Tapeworm Draught.

Liquid extract of male fern, a drachm and a half.
Syrup of ginger, one drachm.
Tincture of quillaia, half a drachm.
Water, an ounce and a half.

Taken fasting, after the bowels have been freely opened by a dose of castor oil.

7. Antispasmodic Drops, No. 1.

Sulphuric ether, one ounce.
Tincture of opium, one ounce.
Chloroform, one ounce.
Rectified spirit, one ounce.

The dose is ten drops in water, for flatulence.

8. Antispasmodic Drops, No. 2.

Oil of cajeput, one drachm.
Oil of cloves, one drachm.
Oil of peppermint, one drachm.
Alcohol, to two ounces.

Ten drops on sugar, occasionally, for flatulence.

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9. Antispasmodic Drops, No. 3.

Thymol, two grains.
Camphor, five grains.
Compound tincture of lavender, half an ounce.
Tincture of myrrh, half an ounce.
Alcohol, to two ounces.

From five to ten drops to be taken on sugar when necessary.

10. Benzol Drops.

Benzol, three drachms.
Oil of peppermint, one drachm.
Olive oil, two ounces.

Ten drops on sugar every four hours for bronchitis.

III.—LINCTUSES.

1. Morphine Linctus.

Solution of hydrochlorate of morphine, three minims.
Spirit of chloroform, three minims.
Syrup of lemon, fifteen minims.
Water, to a drachm.

To be taken frequently when the cough is troublesome.

2. Apomorphine Linctus.

Hydrochlorate of apomorphine, one twenty-fifth of a grain.
Hydrochlorate of morphine, one thirty-third of a grain.
Dilute hydrochloric acid, two minims.
Glycerine, ten minims.
Water, to a drachm.

May be taken frequently as an expectorant.

3. Codeine Linctus.

Codeine, one-eighth of a grain.
Spirit of chloroform, three minims.
Syrup of Virginian prune, ten minims.
Water, to a drachm.

4. Creasote Linctus.

Creasote, one minim.
Glycerine, twenty minims.
Water, to half an ounce.

5. Squill Linctus.

Syrup of squill
Syrup of poppies
Syrup of lemons
Syrup of tolu } equal parts.

The dose is a tea-spoonful frequently.

IV. PILLS.

1. Alterative Pill.

Compound extract of colocynth, one grain.
Blue Pill, one grain.
Powdered ipecacuanha, a quarter of a grain.
Extract of henbane, one grain.

One pill at bedtime.

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2. Aperient Pill.

Compound colocynth pill, two grains.
Blue pill, a grain and a half.
Ipecacuanha, one-third of a grain.
Extract of henbane, one grain.

This is the same as the preceding pill, but somewhat stronger.

3. Strong Aperient Pill.

Socotrine aloes, two grains.
Colocynth, one grain.
Gamboge, one grain.
Oil of cassia, half a minim.
Compound decoction of aloes, enough to make a pill.

This is considerably stronger.

4. Croton Oil Pill.

Croton oil, half a minim.
Extract of colocynth, two and a half grains.
Gingerin, one-eighth of a grain.
Hard soap, two grains.

This is a still stronger pill.

5. Diuretic Pill.

Powdered digitalis, half a grain.
Squill, one grain.
Blue pill, three grains.

One pill at bedtime.

6. Astringent Pill.

Sulphate of copper, a quarter of a grain.
Extract of opium, a quarter of a grain.
Confection of roses, enough to make a pill.

Useful in hæmorrhage from the intestines.

7. Expectorant Pill.

Ipecacuanha, half a grain.
Guiacum, one grain.
Opium, half a grain.
Compound pill of squill, two grains.

8. Lozenge Pill.

Hydrochlorate of morphine, one thirty-sixth of a grain.
Extract of liquorice, three grains.
Compound powder of tragacanth, five grains.

This formula, made into a "lozenge-pill," will be found useful in relieving the cough of phthisis. One should be sucked slowly several times a day.

9. Morphine and Conium Pill.

Hydrochlorate of Morphine, one-eighth of a grain.
Extract of conium, two grains.
Ipecacuanha, half a grain.

Usually taken at bedtime.

10. Codeine Pill.

Codeine, half a grain.
Powdered liquorice-root, two grains.
Treacle, enough.

Useful in coughs.

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11. Tar Pills.

Tar (*pix liquida*), two grains.
Lycopodium, one grain.

Two every four hours.

12. Valerianate of Zinc Pill.

Valerianate of zinc, one grain.
Compound pill of assafœtida, two grains.
Confection of roses, one grain.

13. The Pill of the Three Sulphates.

Sulphate of quinine, one grain.
Sulphate of iron, one grain.
Sulphate of zinc, one grain.
Extract of gentian, two grains.

14. Lithia and Sulphur Pill.

Benzoate of Lithia, three grains.
Precipitated sulphur, two grains.
Salicylate of quinine, half a grain.

For chronic gout.

15. Picrotoxin Pills.

Picrotoxin, one-sixtieth of a grain.
Sugar of milk and glycerine of tragacanth, enough to make a pilule.

One at bedtime, to check the night sweating of phthisis, to be repeated if necessary.

16. MUSK PILLS.

Musk, two grains.
Sugar of milk, enough to make twelve pills.

One or two, three times a day as a nervine stimulant in cases of hysteria, attended with flatulence. Musk costs half a crown a grain.

V. LINIMENTS.

1. COMPOUND TURPENTINE LINIMENT.

Oil of turpentine, three ounces.
Acetic acid, half an ounce.
Oil of lemon, half a drachm.
Yolk of egg, one.
Rose water, to six ounces.

2. TURPENTINE AND AMMONIA LINIMENT.

Turpentine liniment, six drachms.
Solution of ammonia, six drachms.
Oil of cajeput, fifteen minims.
Olive oil, to two ounces.

3. CANTHARIDES AND AMMONIA LINIMENT.

Strong solution of ammonia, one hundred and sixty minims.
Glycerine, one hundred and sixty minims.
Tincture of cantharides, eighty minims.
Almond oil, six drachms.
Spirit of Rosemary, twenty minims.
Water, to four ounces.

4. Compound Aconite Liniment, No. 1.

Tincture of aconite, one ounce.
Chloroform, one ounce.
Soap liniment, six ounces.

For external application only.—"Poison."

5. Compound Aconite Liniment, No. 2.

Tincture of aconite, two drachms.
Camphor, two drachms.
Chloroform, two drachms.
Oil of cajeput, two drachms.
Rectified spirit, to six ounces.

"Poison."

6. Compound Chloroform Liniment.

Tincture of opium, two drachms.
Tincture of capsicum, half an ounce.
Spirit of camphor, one ounce.
Ether, one ounce.
Chloroform, to four ounces.

7. Chloral and Camphor Liniment.

Chloral Hydrate, one drachm.
Camphor, one drachm.
Chloroform, two drachms.
Sulphuric ether, one drachm.
Tincture of opium, one drachm.
Oil of origanum, half a drachm.
Oil of sassafras, half a drachm.
Rectified spirit, to eight ounces.

Rub the chloral up with the camphor.

8. Amber Liniment.

Oil of amber, two drachms.
Oil of rosemary, one drachm.
Oil of origanum, one drachm.
Oil of turpentine, two ounces.
Linseed oil, to four ounces.

VI.—OINTMENTS.

1. Compound Belladonna Ointment.

Belladonna ointment.
Mercurial ointment.
Iodide of potassium ointment.
Of each equal parts.

2. Cocaine Ointment.

Camphor, one drachm.
Cocaine, ten grains.
Oil of bergamot, two minims.
Zinc ointment, three drachms.
Lanoline, three drachms.

3. Cocaine and Menthol Ointment.

Hydrochlorate of cocaine, five grains.
Menthol, ten grains.
White vaseline, one ounce.

4. Oleate of Zinc Ointment.

Oleate of zinc, two drachms.
Oil of verbena, one minim.
Lanoline, to an ounce.

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5. Compound Zinc Ointment.

Oxide of zinc, one drachm.
Calamine, one drachm.
Carbonate of bismuth, three drachms.
Glycerine, three drachms.
Carbolic acid, forty minims.
Oil of rose geranium, three minims.
Lanoline ointment, to two ounces.

6. Compound Sulphur Ointment.

Precipitated sulphur, two drachms.
Carbonate of potassium, one drachm.
Vermilion, two grains.
Oil of bergamot, two minims.
Benzoated lard, one ounce.

7. Storax Ointment.

Prepared storax, two drachms.
Lard, one ounce.

8. Boracic Acid Ointment.

Boracic acid, half a drachm.
Powdered arrowroot, one drachm.
Cold cream, one ounce.

9. Calamine Ointment.

Calamine, two drachms.
Oxide of zinc, half a drachm.
Oil of lavender, two minims.
Lanoline, half an ounce.
White vaseline, half an ounce.

10. Dermatol Ointment.

Dermatol, two drachms.
Oil of neroli, two minims.
White vaseline, one drachm.
Lanoline, to an ounce.

11. Huile de Cade Ointment.

Oil of cade, half a drachm.
Camphor, five grains.
Nitrate of mercury ointment, to an ounce.

For chronic eczema and psoriasis.

12. β. Naphthol Ointment.

β. Naphthol, ten grains.
Camphor, ten grains.
Tar ointment, one ounce.

For chronic eczema, psoriasis, and lupus.

13. Alkanet Ointment.

Crushed alkanet root, fifteen grains.
Otto of roses, two minims.
White wax, four grains.
Prepared lard, one ounce.

14. Calendula Ointment.

Tincture of calendula, three drachms.
Lanoline ointment, one ounce.

This preparation, made from the common marigold, is an excellent application for indolent ulcers and for broken chilblains.

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VII.—INJECTIONS.

1. Chloride of Zinc Injection.

Chloride of zinc, ten grains.
Glycerine, one ounce.
Acetate of morphine, two grains.
Water, to four ounces.

For urethral injection.—"Poison."

2. Bismuth Injection.

Carbonate of bismuth, forty grains.
Acetate of morphine, two grains.
Rose water, to four ounces.

The urethral injection.—"Poison."

3. Brown Injection, No. 1.

Sulphate of zinc, half a drachm.
Acetate of lead, one drachm.
Powdered catechu, one drachm.
Tincture of opium, one drachm.
Elder-flower water, to four ounces.

For gonorrhœa and gleet.

4. Brown Injection, No. 2.

Acetate of lead, twelve grains.
Acetate of zinc, twenty-four grains.
Tincture of opium, a drachm and a half.
Tincture of catechu, fifty minims.
Powdered gum acacia, a drachm and a half.
Elder-flower water, two ounces.
Rose water, to six ounces.

For chronic urethritis.

5. Lead and Opium Injection.

Sulphate of zinc, fifteen grains.
Acetate of lead, half a drachm.
Extract of opium, five grains.
Tannin, two grains.
Rose water, to four ounces.

6. Vaginal Injection.

Alum, one drachm.
Sulphate of zinc, one drachm.
Permanganate of potassium, one grain.
Heliotropin, one grain.

The powder to be dissolved in a pint of tepid water, and used as a vaginal douche.

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VIII.—GARGLES.

1. Capsicum Gargle.

Tincture of capsicum, three drachms.
Dilute nitric acid, three drachms.
Infusion of red gum, to twelve ounces.

2. Chlorate of Potash Gargle.

Chlorate of potassium, twenty-five grains.
Dilute acetic acid, half a drachm.
Syrup of raspberry, half an ounce.
Water, to ten ounces.

3. Borax Gargle.

Glycerine of borax, six drachms.
Tincture of myrrh, one hundred minims.
Eau de Cologne, half a drachm.
Water, to six ounces.

4. Tannic Acid Gargle.

Tannic acid, a drachm and a half.
Glycerine, half an ounce.
Compound infusion of roses, to four ounces.

5. Carbolic Acid Gargle.

Carbolic acid, ten minims.
Chlorate of potassium, two drachms.
Glycerine, one ounce.
Water, to four ounces.

6. Phytolacca Gargle.

Tincture of phytolacca, four drachms.
Carbolic acid, ten minims.
Dilute acetic acid, two drachms.
Tincture of myrrh, one drachm.
Eau de Cologne, two drachms.
Water to eight ounces.

Useful in the catarrhal laryngitis, from which singers and public speakers so frequently suffer.

IX. INHALATIONS.

1. Cubebs Inhalation.

Oil of cubebs, half a drachm.
Oil of lemons, ten minims.
Light carbonate of magnesium, twenty grains.
Water, to an ounce.

A tea-spoonful in a pint of water, at 140° F., the vapour to be inhaled for ten minutes.

2. Benzoin Inhalation.

Compound tincture of Benzoin, one ounce.

A tea-spoonful in a pint of water, at 140° F.

Sedative in acute inflammation pharynx and larynx.

3. Conium Inhalation.

Dried carbonate of sodium, twenty grains.
Water, at 140° F., twenty ounces.
Dissolve and add conium juice, two drachms.

Sedative.

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4. Myrtle and Juniper Inhalation.

Oil of myrtle, ten drops.
English oil of juniper, twenty drops.
Light carbonate of magnesium, twenty grains.
Water, to an ounce.

A tea-spoonful, at 140° F.
Acute tonsilitis and vocal weakness.

5. Sage and Origanum Inhalation.

Oil of sage, ten minims.
Oil of thyme, five minims.
Oil of nevoli, two drops.
Light carbonate of magnesium, ten grains.
Water, to an ounce.

A tea-spoonful, at 140° F.
Stimulant.

6. Inhalation of Menthol and Benzol.

Menthol, eight grains.
Chloroform, five minims.
Benzol, forty minims.
Oil of cassia, two minims.
Light carbonate of magnesium, twenty grains.
Water, to an ounce.

A tea-spoonful in a pint of hot water for each inhalation.

7. Inhalation of Creasote.

Creasote, forty minims.
Tincture of quillaia, ten minims.
Water, to an ounce.

A tea-spoonful in a pint of hot water for each inhalation.

8. THYMOL INHALATION.

Thymol, six grains.
Rectified spirit, one drachm.
Light carbonate of magnesium, five grains.
Water, to an ounce.

A tea-spoonful, at 140° F.
Stimulant and disinfectant.

X. FUMING INHALATIONS.

No. 1.

Powdered anise fruit, one ounce.
Powdered stramonium leaves, two ounces.
Powdered sumbul root, one drachm.
Powdered nitre, one ounce.

To be carefully mixed.
A tea-spoonful or more to be ignited and the fumes inhaled.

No. 2.

Powdered fennel fruit, one ounce.
Powdered stramonium leaves, one ounce.
Black tea, in powder, one ounce.
Iodide of potassium, one drachm.
Nitrate of potassium, one ounce.

No. 3.

Powdered stramonium leaves, one ounce.
Powdered cascarilla, one ounce.
Powdered frankincense, two drachms.
Powdered myrrh, two drachms.
Powdered nitrate of potassium, one ounce and a half.

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XI. EYE-DROPS.

1. Atropine Eye-drops.

Sulphate of atropine, one grain.
Water, to an ounce.

2. Homatropine Eye-drops.

Hydrobromate of homatropine, two grains.
Water, to an ounce.

3. Eserine Eye-drops.

Sulphate of eserine, two grains.
Water, to an ounce.

4. Pilocarpine Eye-drops.

Nitrate of pilocarpine, two grains.
Water, to an ounce.

5. Homatropine and Cocaine Drops.

Hydrobromate of homatropine, two grains.
Hydrochlorate of cacaino, ten grains.
Water, to an ounce.

XII. ATOMIZING SOLUTIONS.

No. 1.

Pure terebene, two drachms.
Oil of sandal-wood, one drachm.
Oil of cubebs, one drachm.
Oil of lemons, one drachm.
Paroleine, to two ounces.

To be used in an atomizer or nebulizer for chronic bronchitis and emphysema.

No. 2.

Cocaine, ten grains.
Menthol, one drachm.
Camphor, one drachm.
Oil of vaseline, to four ounces.

A mild local anæsthetic for the nose, throat, and adjacent parts.

No. 3.

Guaiacol, one drachm.
Oil of eucalyptus, half a drachm.
Oil of gaultheria, one drachm.
Oil of cassia, one drachm.
Firwood oil, one drachm.
Oil of vaseline, to four ounces.

This is antiseptic, and is used in cases of phthisis.

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XIII. BATHS.

1. Nitro-Hydrochloric Acid Bath.

Nitric acid, fifteen fluid ounces.
Hydrochloride acid, twenty-five fluid ounces.
Aromatic vinegar, four ounces.
Water, at 90° F., thirty gallons.

2. Alkaline Bath.

Bicarbonate of sodium, four ounces.
Oil of Bergamot, ten drops.
Water, at 95° F., thirty gallons.

3. Bran Bath.

Wheaten bran, four pounds.
Water, thirty gallons.

Tie the bran in a muslin bag, macerate it for ten minutes in water, at 185° F., then add more water till the temperature of the bath is 95° to 100° F.

4. Size Bath.

Clarified size, six pounds.
Florida water, four ounces.
Boiling water, one gallon.
Water, at 98° F., to thirty gallons.

5. Salt Bath.

Bay salt, ten pounds.
Bay rum essence, one drachm.
Water, thirty gallons.

DAINTY DIET IN SICKNESS AND IN HEALTH.

DIETARY.

1. Arrowroot.

A dessert-spoonful of arrowroot will thicken half a pint of milk. The arrowroot should be placed in a tea-cup or small basin, and should be thoroughly mixed with a small quantity of cold water until all the lumps are broken down; then add by degrees the boiling milk, and constantly stir the mixture. It may be flavoured with sugar, and a little nutmeg, or other kind of spice, or lemon-peel may be added.

2. Gruel.

Put the groats or oatmeal into a saucepan, pour a little cold water upon them, and mix well; add more cold water, and stir occasionally. Boil slowly, and continue to stir; strain it, and add sugar or salt. A pint of water to an ounce of groats is the proportion, and this quantity requires three-quarters of an hour's boiling.

3. Peptonized Milk.

Take a pint of good fresh milk, which should be tested with litmus paper, to see that it is not acid, dilute with

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a quarter of a pint of water, if this has not already been done by the milkman, add five grains of zymine and fifteen grains of bicarbonate of sodium—they can be obtained ready mixed in air-tight tubes—pour into a clean bottle and let it stand before the fire or in a basin containing water as hot as the hand will bear. Shake frequently, and taste from time to time. As soon as any bitter taste can be detected, which will probably be in about twenty minutes, put the bottle on ice, and when quite cold take in small quantities, from a table-spoonful upwards. When ice is not obtainable, boil briskly for a few minutes, when the action of the ferment will be permanently arrested.

4. Peptonized Milk Gruel, No. 1.

A good thick gruel is made with oatmeal, and whilst still boiling-hot an equal quantity of cold milk is added, so as to reduce the temperature to 140° F. To each pint of this mixture one zymine powder is added, the whole being well shaken up together in a bottle, which is then placed in front of the fire and allowed to stand for half an hour. It is next boiled for a few minutes, and, after being strained, is ready for use.

5. Peptonized Milk Gruel, No. 2.

Beat up both the white and yolk of an egg until quite smooth and free from stringy particles. Stir it well into half a pint of tepid milk in which enough arrowroot has been boiled to make it of the consistence of thick cream. Add five grains of zymine, and fifteen grains of bicarbonate of sodium, allowing it to stand in a warm place until there is just a suspicion of bitterness. Then boil briskly for a minute, and add a wine-glassful of sherry or a table-spoonful of brandy.

6. Caudle.

Beat up an egg to a froth, add a glass of sherry, and half a pint of gruel.

7. Posset.

To half a pint of milk, boiling in a saucepan, add a glass of sherry, sweeten with pounded sugar, and strain.

8. Whey.

Curdle warm milk with rennet, and strain off the opalescent liquid for use. This is a favourite drink in many complaints, and in several parts of Germany invalids resort to particular localities to undergo the so-called "Whey Cure." It is diaphoretic and also diuretic.

9. Treacle Whey.

Pour two or three table-spoonfuls of treacle into a pint of boiling milk, and afterwards let it boil up well, and strain. This is drunk as hot as possible when the patient is in bed at night, and is regarded by many as a sovereign remedy for a cold.

10. Tamarind Whey.

Stir two table-spoonfuls of tamarinds into a pint of milk whilst boiling, and afterwards strain. This is recommended as a refrigerant and slightly laxative drink.

11. Orgeat.

Bleach two ounces of sweet almonds and four bitter almond seeds. Pound with a little orange-flower water into a paste, and rub this with a pint of milk diluted with a

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pint of water until it forms an emulsion. Strain, and sweeten with sugar.

12. Narissa.

Take a breakfast-cupful of boiling milk. Mix a dessert-spoonful of narissa with a little cold milk, stirring it in until it forms a paste. Then add to it a little hot milk, and, when thoroughly mixed, add to the remaining milk. Boil for five minutes, stirring constantly, and flavour with the smallest possible quantity of vanilla pod. Narissa is a good food for convalescents.

13. Beef Tea, No. 1.

Take one pound of the best rump steak; see that it is free from fat, and cut into small cubes half the size of dice; place these in a jar provided with a lid; pour half a pint of cold water over them, and let them stand for three hours; pour off the liquid, and set it aside. Next, pour another half-pint of water on the meat; gradually raise it to a temperature of 160° F., and keep it at this temperature for three hours. Now pour off this second liquid, and add it to the first. Lastly, pour upon the meat half a pint of boiling water, and keep it just boiling or simmering for three hours, then pour off the liquid, and add it to the other two portions.

14. Beef Tea, No. 2.

From a good piece of gravy-beef cut away every particle of fat, and then either scrape it into shreds with a knife or cut it into very small pieces. Put it into an earthenware jar with a lid, add cold water sufficient to just cover the meat, put on the lid, and place the jar in a saucepan of warm water, and stand it by a good fire or on a hot plate or oven, where it will simmer without boiling; it will

require to stand for some hours before it is really good. When the meat becomes white and sodden-looking, it is ready. If not quite hot after the meat has been taken out, the beef tea should be put into a saucepan and heated, unless the patient prefers it cold.

15. Peptonized Beef Tea.

Take half a pound of finely-minced lean beef, add to it a pint of cold water, and cook over a gentle fire till it boils. Decant the liquid portion into a clean jar or into a bottle, rub up the meat into a paste, and add it to the beef tea. Add more water, till the temperature is reduced to 140° F., then stir in a drachm of zymine, and twenty grains of bicarbonate of sodium. Then stand it before the fire for three hours, shaking occasionally, and finally either place it on ice or boil quickly for a few minutes, and strain.

16. Beef Essence, No. 1.

Take one pound of gravy beef, free from skin and fat, chop it up as fine as mincemeat, pound it in a mortar with three table-spoonfuls of water, and let it soak for two hours. Then put it in a covered earthen jar with a little salt, cementing the edges of the cover with pudding paste, and tying a piece of cloth over the top. Place the jar in a pot half full of boiling water, and keep the pot on the fire four or five hours. Strain off through a coarse sieve (so as to allow the smaller particles of meat to pass) the essence, which should measure a quarter of a pint. Give two table-spoonfuls or more occasionally.

17. Beef Essence, No. 2.

Take one pound of rump steak, mince it like sausage-meat, and mix it with a pint of cold water. Place it in

a pot at the side of the fire to heat very slowly. Let it stand two or three hours before it is allowed to simmer, and then boil gently for fifteen minutes. Skim, and serve. The addition of a table-spoonful of cream to a tea-cupful of this beef tea renders it richer and more nourishing. It may be thickened with a little flour or arrowroot.

18. Mutton Broth.

Take one pound of the scrag end of neck of mutton, two pints of water, pepper and salt, half a pound of potatoes, and some pearl barley. Put the mutton into a stewpan, pour water over it, and add pepper and salt. When it boils, skim carefully, cover the pan, and let it simmer gently for an hour. Strain, let it get cold, and then remove the fat. When required for use, add the pearl barley and the potatoes in the following manner:—Boil the potatoes, mash them very smoothly, so that no lumps remain, put them into a pan, and gradually add the mutton broth, stirring until it is well mixed and smooth; let it simmer for five minutes, and serve with fried bread. The addition of a little Parma cheese will improve the flavour, whilst chervil is a good pot-herb.

19. Chicken Broth, No. 1.

A small chicken or half a large fowl, thoroughly cleaned, with all the fat and skin removed, is to be chopped, bones and all, into small pieces. Put this, with a due allowance of salt, into a saucepan and add a quart of boiling water, cover closely, and simmer over a slow fire for two hours. After removing allow to stand, still uncovered, for an hour, and strain through a sieve.

20. Chicken Broth, No. 2.

Take two fowls, skin them, cut them in pieces, and put them in a stock-pot, with an ounce of equal parts of aniseed, caraway, cumin, and fennel, contained in a muslin bag. Boil for three hours, skim, strain through a napkin, and serve.

21. Chicken Jelly.

Take a small chicken, and, after careful cleaning, pound it with a mallet, bones and all. Cover it well with a quart of cold water and heat slowly in a covered vessel, letting it simmer until the meat is in rags and the liquid is reduced by a half. Strain and press first through a colander and then through a coarse cloth. Add pepper and salt to taste, and then return it to the fire, letting it simmer five minutes longer. Skim when cool and place it on ice. It is served cold with thin biscuits, or it may be made into sandwiches.

22. Linseed Jelly.

Half a pound of linseed to three pints of cold water. Let them simmer for two hours, then squeeze through muslin. When cold it will be in a jelly. Sweeten and flavour to taste. A breakfast-cup once a day, or oftener, with the juice of one lemon.

23. Calf's Foot Jelly.

Procure two calf's feet or a cow heel with the hair on. To get the hair off, hold the foot in a saucepan of boiling water so that the water just covers the hair; in five to ten minutes the hair can be easily scraped off with a knife. Put the feet into about five pints of water and boil them till half the water has evaporated; strain, and when cold, take off the fat. Put it into a saucepan with wine, sugar, lemon-juice,

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and lemon-peel, according to taste. To clear the jelly, the whites of five eggs well beaten up to a froth, and the shells, broken up, must be added. Set the jelly on the fire, but do not stir it after it begins to warm; when it comes to a head, let it boil for twenty minutes. Prepare a conical bag of coarse flannel, with two strings on the broad part, with which to tie it to the backs of two chairs. Dip the bag in hot water, and squeeze it dry. Having placed a shape under the point of the bag, pour the contents of the saucepan carefully into it, so that it runs slowly through into the shape. Do not press the bag, or the jelly will be cloudy.

24. Champagne Jelly.

Soak an ounce and a half of gelatine in half a pint of water for a quarter of an hour; then add the juice and rind of one lemon, two ounces of powdered white sugar, and the white of an egg. Whisk over the fire till it boils, then add a little cold water; let it stand in front of the fire for five minutes, then strain through muslin previously rung out of hot water. Put the gelatine into a basin; add a large bottle of champagne and a glass of curaçoa, and pour into a shape. When firm dip the shape for a moment into tepid water and turn out.

25. Port Wine Jelly.

Put into a glass jar a pint of port wine, two ounces of isinglass, two ounces of good gum arabic, and two ounces of white sugar-candy. Put the jar into a saucepan of hot water, and let it stand near the fire until the isinglass, sugar, and gum are dissolved. Then add a small glass of maraschino, and strain into a mould. It may be served up with cream, or a small piece may be taken frequently for the relief of sore throat or cough. If the jelly is at all leathery it is the fault of the isinglass.

26. Aspic Jelly.

Take a calf's foot, chop it into pieces, and wash them well in cold water. Put them into a stewpan with sufficient water to cover them, and boil; as soon as the water boils, take the pieces out and wash them again in cold water. Then put them back into the stewpan with a pound of knuckle of veal cut into small pieces. Pour three-quarters of a pint of water on these, and bring it to the boil; skim it carefully. Now add a little salt, fifteen peppercorns, half a clove of garlic, one shalot, one sprig of thyme, and a sprig of parsley, one onion, and half a head of celery, one carrot, and a turnip—all peeled and washed—add also two sprigs of tarragon, one chervil, and a bay-leaf. Boil gently for five hours, then strain off the liquor through a sieve into a basin. When cold, skim off the fat with a spoon. Take a clean cloth, wring it out of hot water, and rub it lightly over the jelly stock, and then take a dry cloth to dry it. Peel a lemon very thinly and put it into the stewpan; squeeze the juice out through a strainer, and whip the whites of two eggs to a froth. Put these and the egg-shells into the stewpan with the stock, a glass of sherry, and a dessert-spoonful of Chili vinegar. Whisk this all together till it boils. Then take a spoon and skim it carefully, and let the stewpan stand by the side of the fire for half an hour to form a crust. Then take a clean jelly-bag; make it hot, and strain the stock through it, repeating the operation if necessary.

27. Aspic Chicken.

Pour into a mould some aspic jelly to the depth of a quarter of an inch. When this is set, cut some shapes of hard-boiled eggs, truffles, gherkins, and beetroot; arrange these in patterns round the mould; pour in some nearly

liquid aspic jelly gently, and put it on ice to freeze. Arrange fillets of chicken, previously cooked, skinned, and cut in a good shape, neatly all round. Pour in as much more of the aspic as will set the chicken, then put round and over the chicken some mayonnaise, and over this more cold aspic. Fill up the mould with liquid aspic, and put it to freeze. Turn out, and serve with whisked aspic and endive as a garnish round it.

28. Chicken Purée.

The meat should be cut up fine, and simmered in a saucepan until it is pulpy and sufficiently soft to pass through a hair sieve or tamis cloth. Sometimes it is necessary to pound the meat with a pestle and mortar before it can be got to pass through the sieve. Place the sieve upside-down on a dish, put the meat on the sieve, and then proceed to rub it through the sieve by means of a spoon or a stick with a rounded end. It may be necessary to add a little water, milk, or other liquid, in order to get the purée to pass the easier. The meat in a purée is in the finest possible state of division, and is consequently in a very digestible condition. A purée may be made of any kind of meat; but that prepared with chicken is most easy of digestion and is most palatable.

29. Panada.

Take the white part of the breast or wings, freed from skin, of either roast or boiled chicken, or the under side of cold sirloin of beef or cold roasted leg of mutton, and pound in a mortar with an equal quantity of stale bread. Add either the water in which the chicken has been boiled, or beef tea, until the whole forms a fluid paste, and then boil for ten minutes, stirring all the time. Pheasant or partridge

panada may be prepared in the same way, whilst venison panada will please the sick sportsman.

30. Cream of Chicken.

Pound the breast in a mortar, pass through a wire sieve, put into a mould with three table-spoonfuls of cream and the yolk of an egg; season well, and steam for twenty minutes. It should be served with sweet red capsicums.

31. Chicken Breasts.

These should be stewed with a little butter in their own juice, and served with small fresh grilled mushrooms. Preserved mushrooms should not be used, as they are hard and indigestible.

32. Neapolitan Soup.

Cut into very small pieces the heart of a small cabbage, half a small beetroot, two turnips, two carrots, half a small lettuce, the quarter of a stick of celery, and a small bunch of parsley, salt to taste, and add one quart of stock; stew over slow fire for one hour; serve with fried bread.

33. Plain Boiled Sole.

Thoroughly wash and clean a sole, and put it into plenty of cold water, with salt in the proportion of one ounce to the quart; bring it gently to the boil, put it aside to simmer for five or ten minutes, according to size. When ready, place it in a clean napkin, garnish with parsley and slices of lemon, and serve with sauce. Violent boiling should be avoided.

Whenever sea-water is available for boiling fish it should be preferred to salted water.

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Soles do not keep well, and should be eaten as fresh as possible. If kept on ice they soon deteriorate in quality and become flabby. Small soles caught in shallow water on the coast are the best.

34. Fish Chowder.

To make two quarts. Two pounds of fresh haddock, cod, or turbot, eight potatoes, six onions, a quarter of a pound of salt pork, some lobster spawn, three thick dry biscuits, and a quart of milk. Cut the fish, potatoes, onions, and pork into pieces about half an inch square; put the pork and onions into a saucepan, stir and fry them a light brown. Take out the meat and onions, and put in a table-spoonful of flour to make the foundation of stock; stir it well in, and then put into the saucepan a layer of potatoes, then of fish, then of onions and pork; season well with salt and pepper, and add other layers in the same order until all the materials are used. Cover with water and stew slowly until the potatoes are soft; then add a quart of milk, the lobster spawn, and the biscuits broken into small pieces; stew for ten minutes longer, and serve.

35. Stewed Oysters.

Fifty oysters, one pint of cream, one table-spoonful of butter, half a cup of bread-crumbs, one pint of water, salt and pepper to taste. Drain the oysters in a colander, and wash by pouring cold water over them. Put the bread-crumbs and a pint of water in a stew-pan, and cook five minutes; then add the oysters, and, when boiling hot, add the butter, cream, salt and pepper. Let the whole boil up once, and serve very hot. The oysters must not be over-cooked or they will be hard. Half the quantity makes a dish for five or six people.

36. Broiled Oysters.

Drain twenty-five large oysters and place them on a pastry board, season with Nepaul pepper and dip them in bread-crumbs. Grease an oyster broiler, place the oysters in it side by side, close it, and broil them over a clear fire till they are brown on one side, then turn and broil the other. Serve immediately on squares of buttered toast with a few drops of lemon and a small piece of butter on each oyster.

37. Golden Buck.

Two cups of grated cheese, a quarter of a tea-spoonful of mustard, a dash of Nepaul pepper, one cup of milk, half a tea-spoonful of salt, six squares of buttered toast, six poached eggs. Put the milk on to boil in a porcelain saucepan, add to it the cheese, mustard, salt and cayenne, and stir constantly until the cheese is melted. Have the toast ready, pour enough of the cheese over each piece to cover it, put a poached egg carefully on the top of each piece, dust lightly with pepper and salt, and serve immediately.

38. Devilled Lobster.

Two small lobsters, half a pint of cream, two table-spoonfuls of flour, a quarter of a nutmeg grated, the yolks of four hard boiled eggs, one table-spoonful of butter, one table-spoonful of chopped parsley, cayenne, or Nepaul pepper, and salt to taste. Cut the meat of the lobsters up finely; put the cream on to boil; rub the butter and flour together, add it to the boiling cream, and stir and cook for two minutes. Take the saucepan from the fire and add to the cream the lobster meat, parsley, nutmeg, salt and red

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pepper. Clean the lobster shells and fill them with the mixture, brush over with beaten egg, cover with bread-crumbs, and put them in a quick oven to brown; or, still better, put them in a frying-basket and plunge them into boiling fat or oil until they are of a nice brown colour. Serve in the shells. Crab may be dressed in the same way, and is excellent.

39. Baked Pork and Beans.

Soak a quart of white haricot beans overnight in cold water, and in the morning drain them through a colander. Put them to boil in cold water; at the first boil drain this water off, and cover them with fresh boiling water. Score the rind of a pound of pickled pork (previously well washed in cold water), and put it in with the beans; simmer gently until the skin of the beans can be blown off. To do this, take three or four of the beans in the hand, blow hard on them, and if the skin cracks they are cooked. When done, every bean should be perfectly whole. Now take out the pork and drain it; put the beans into a deep earthen dish with a cover, and almost bury the pork in the middle of them. Add one tea-spoonful of salt to one pint of the water in which the beans were boiled, pour this into the dish, and sprinkle freely with pepper. Pour over the top of the beans a large table-spoonful of treacle or brown sugar, put on the lid, and bake in a very moderate oven from two and a half to three hours, or even more, until the beans are quite soft and the meat thoroughly done. Serve the pork and beans in the dish in which they are baked, and eat Boston brown bread with them.

40. Raw Meat Sandwiches.

Take a pound of good steak, which must be absolutely fresh, place it on a pudding board, and fray it out with

a large blunt knife. Spread the pulp out flat, and carefully remove the white particles of fat and tendon. Place the pulp in a stone mortar and pound it thoroughly. Spread two thin slices of French roll with butter, and put the meat, to which a sufficiency of pepper and salt have been added, in the centre, leaving a clear margin of a quarter of an inch all round. Divide the sandwich into four, and serve it up on a napkin with a little parsley. If the red colour of the pulp is objectionable, add just a little brown sugar when it is being pounded up in the mortar.

An excellent formula for Raw Beef Balls is given in Mrs. Ernest Hart's book.

41. Poached Eggs.

Boil some water in a saucepan, then break an egg into a tea-cup, being careful not to burst it, and place the tea-cup in the saucepan of boiling water. The egg should then be carefully placed upon a piece of toast or a slice of bread and butter.

42. Œufs au Gratin.

Cut some hard-boiled eggs in slices, and lay them on a well-buttered dish, with grated Parmesan cheese, black pepper, and a grate of nutmeg. Sprinkle some baked bread-crumbs over all, put the dish in the oven, and serve as soon as the contents begin to colour.

43. Œufs au Miroir.

Spread a thick layer of fresh butter on a tin or fire-proof china dish, sprinkle with salt, and break the eggs carefully on to it, one at a time; pour some cream over them, season with salt, pepper, and one grate of nutmeg; place a few small lumps of butter over all, bake in the oven, and brown with a salamander.

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44. The Omelette.

Make sure that the fryingpan is perfectly clean, and free from moisture. Place in the fryingpan about one ounce of sweet butter; break three eggs separately, to see that they are fresh; beat them up with a little chopped parsley and a pinch of pepper and salt. The eggs should not be beaten too much (about four seconds will be sufficient), or the white separates, and you produce a watery mixture, which destroys the flavour and appearance of the omelette. Now that the butter is melted, and in a state of froth, pour into the fryingpan the omelette mixture, and stir till it begins to set or thicken. Shake the pan occasionally; and when sufficiently firm, fold the omelette over neatly into an oval shape; strike the handle of the fryingpan so as to produce a gentle vibration, which keeps the omelette detached from the pan, and when the omelette is of a golden colour, turn it quickly in the dish. To be able to prepare a plain omelette is to be able to prepare every kind of omelette. The chief thing to be borne in mind in cooking an omelette is that the mixture does not adhere to the fryingpan.

45. Arrowroot Custard.

Take two cups of boiling milk, three spoonfuls of arrowroot, two table-spoonfuls of white sugar, and one egg. Moisten the arrowroot with a little cold milk, beat the egg up with the sugar. Mix the arrowroot paste with boiling milk, stir for three minutes, then take from the fire and mix in the egg and sugar. Boil two minutes longer, flavour with vanilla, and pour into a mould.

46. Baked Custard Pudding.

Warm half a pint of milk, whisk two eggs, yolks and whites, pour the milk over them, stirring all the while. Have ready a small tart-dish lined at the edges with paste ready baked. Pour the custard into the dish, grate a little nutmeg over the top, and bake it in a very slow oven for half an hour.

47. Boiled Custard Pudding.

Prepare the custard as in the foregoing recipe. Butter a small basin that will exactly hold it, put in the custard, and tie a floured cloth over it; plunge it into boiling water, turn it about for a few minutes; boil slowly for half an hour; turn out, and serve.

48. Rice Pudding, No. 1.

Butter a baking-dish; put a small tea-cupful of rice, a little sugar, and a bit of butter into it; fill the dish with milk, into which two eggs have been well beaten, and grate a little nutmeg over the whole; bake slowly till the rice is quite soft.

49. Rice Pudding, No. 2.

Take an ounce of rice, three-quarters of a pint of milk, half an ounce of butter, one egg, and a little powdered white sugar. Let the rice swell in the milk over a slow fire, stir in the butter, and let the mixture cool. Well beat the egg, and mix with the rice. Line a mould with caramel flavoured with vanilla pod, fill it nearly full, and steam. Serve with thick cream, also flavoured with vanilla.

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50. Tapioca Pudding.

One ounce of tapioca, one pint of milk, one ounce of butter, two eggs, sugar to taste. Wash the tapioca, and let it stew gently in the milk for a quarter of an hour, stirring it now and then. Let it cool, mix with it the butter, sugar, and eggs, which must be well beaten; put it into a small tart-dish, and give it an hour's baking in a moderate oven.

51. Chocolate Pudding.

Mix together in a stewpan the yolks of two eggs, an ounce of butter, an ounce of sugar, and stir till quite thick. Then add a sufficient quantity of potato flour and the whites of the eggs whisked stiff. Steam for twenty minutes, and pour over it hot two tablets of chocolate which have been boiled in syrup for two hours.

52. Egg and Milk.

Beat up the yolk of an egg, add the juice of one lemon, and then sugar to taste. Mix well before adding the milk, or curdling takes place. Add enough milk to the egg and lemon to nearly fill a breakfast-cup.

53. Lemon Cream.

Take three large lemons; grate the peel of one of them and mix it with all the juice in a glass dish. Boil ten ounces of sugar in a quart of cream flavoured with vanilla pod—not the essence. When it has ceased boiling pour it into the lemon juice and stir very gently.

54. Lemonade.

Peel one lemon or more, according to the quantity required and the size of the fruit. Pour a small quantity of

boiling water over the peel, and cover it close. Squeeze the lemon, and remove the pips. Pour some boiling water upon sugar in a separate vessel; when the sugar is perfectly dissolved, put the juice into it, add cold water, tasting as you proceed till you find the drink does not taste too strongly of the juice; then put in enough of the peel to flavour it according to taste. Lemons differ so much in the quantity of juice they yield, and even in the strength of the acid, that accurate directions as to quantities are useless; you must be guided by the taste. Be careful to dissolve the sugar in water before you add the juice. Oranges may be used with or instead of lemons.

55. Iced Lemonade.

Grate the rind of four large lemons, and mix with it one pound of sugar. Squeeze the juice of the four lemons, and pour over the sugar. Put all in a glass jar. Allow one table-spoonful for each glass of iced water.

56. Lemon Syrup.

Take two large lemons, two and a half pounds of powdered sugar, one ounce of citric acid, and a quart of water. Roll the lemons, peel and squeeze them, using only half the peel. Remove the pips, and boil with the sugar and water for a quarter of an hour. Pour into a jug and dissolve the acid by stirring. Let it stand until the following day, then bottle and keep in a cool place. A table-spoonful in a tumbler of effervescing water makes a lemonade which is ready at a moment's notice.

57. Egg Lemonade.

Take the white of an egg, a table-spoonful of powdered sugar, the juice of one lemon, beat them together, and add to a tumbler of iced water.

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58. Egg and Rum Cordial.

Take six eggs, which must be absolutely new laid, put them in a bowl and cover them, shells and all, with the juice of seven lemons, or of as many as may be required. Fresh lime juice will answer equally well, or if neither lemons nor limes are procurable, a solution may be made of half an ounce of citric acid in four ounces of water. The eggs should be turned over from time to time so as to expose them fully to the action of the acid. In twenty-four hours the shells will be dissolved, the membrane lining the shells should then be picked out and removed, and the eggs thoroughly beaten up in the solution. A pint of good old rum should then be added, and after the addition of a little cinnamon and ginger the cordial should be poured into a clean bottle and carefully corked up. It may be used at once, but improves by keeping. A table-spoonful three times a day is a useful stimulant in phthisis, and in convalescence from acute illness.

59. Blackberry Cordial.

Squeeze enough blackberries to make two pints of juice, add a pound of loaf sugar, and let it dissolve by heating it slowly. Add a tea-spoonful each of cloves, cinnamon, and nutmeg. Boil for twenty minutes, and on removing from the fire add a wine-glass of brandy. Put in bottles while hot, and seal. A tea-spoonful to a glass of iced water.

60. Raspberry Vinegar.

Fill a half gallon glass jar with fresh raspberries; pour over them as much cider vinegar as the jar will hold. Screw on the cover, and let them stand for one week, then scald and pour in a jelly bag and let them drain; to the juice add loaf sugar in the proportion of one pound to every

pint. Boil fast for twenty minutes, and skim when any scum arises; while still hot decant it into bottles or glass jars. A spoonful in a glass of iced water.

61. Cream Soda.

Boil together for a few minutes, three pints of water, two pounds of white sugar, the juice of two lemons, and two ounces of tartaric acid. Set it aside to cool. Beat up the whites of three eggs to a stiff froth; slowly sift in it a half cup of flour and stir until smooth, then flavour with half an ounce of essence of wintergreen. When the syrup is nearly cool stir in the eggs. When cold put it in a stone jug which has been scalded until perfectly sweet. Cork tightly, and keep in a cold place. Two table-spoonfuls of the syrup in a glass of cold water, and just before drinking add a quarter of a tea-spoonful of bicarbonate of soda and stir well.

62. Rode Groed.

Take a quart of the juice of equal quantities of raspberries and red currants passed through a hair sieve, four ounces of German semolina, one ounce of isinglass, and a pound and a half of loaf sugar. Oil a China mould, and boil for ten minutes. Serve cold, with plenty of good cream.

63. Washington Cake.

Two pounds of flour, one quart of milk, with an ounce of butter, heated together; put the milk and butter into the flour when it is about lukewarm, add one gill of good yeast, three eggs, and a tea-spoonful of salt. Place it in a pan over night, and bake it in the morning in a quick oven for three-quarters of an hour.

64. Boston Brown Bread.

Mix two cups of rye meal and two cups of Indian meal well together, dissolve a tea-spoonful of soda in two table-spoonfuls of boiling water, then add it to a pint and a half of sour milk. Mix with it one cup of molasses or treacle, and pour it over the meal, add the salt, and stir all thoroughly well. Pour the mixture into a well-greased two-quart bread mould, put the lid on, and steam for five hours. Then remove the lid, put it in the oven, and bake for thirty minutes.

65. Waffles.

Waffles may be made with a fermented thin dough or sponge, or with a stirred dough of which flour, eggs, butter, and milk are the only ingredients. The rising of the waffles may be effected by the addition of whipped cream or whipped white of egg to the dough. The waffling-irons, according to Dr. Thudichum, who is an authority on the subject, should be thick, so as to favour an equal distribution of the heat and present as large a surface as possible to the contact with the dough.

An excellent "Dictionary of Culinary Terms" will be found in Dr. Thudichum's "Spirit of Cookery."

By far the best collection of *ménus* and recipes for diabetics, and of dishes for the gouty will be found in Mrs. Ernest Hart's recent work on "Diet in Sickness and Health."

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EXAMINATION QUESTIONS.

EXAMINATION PAPERS.

These are examples of examination papers set during the last fourteen years at the Westminster Hospital, and are more or less adapted to the requirements of students preparing for the examinations of the Conjoint Board.

No. 1.

1. What do you understand by the terms "materia medica," "pharmacology," and "therapeutics"? Illustrate your answer by examples. What agents other than drugs are employed in the treatment of disease?

2. Describe the several ways in which *extracts* are prepared, and mention the varieties of extracts that occur in the pharmacopœia.

3. What is *dialyzed iron?* In what doses is it employed? How does it differ from the perchloride of iron? Give the official preparations and doses of the latter.

4. Enumerate the official compounds and preparations of *arsenic.* What are the symptoms of (*a*) acute and of (*b*) chronic poisoning by arsenic?

5. Name the active principles of *opium*, and give an account of the physiological actions and therapeutical uses of *codeine.*

6. Give an account of the physiological actions and therapeutical uses of *cantharides.* What is meant by "counter-irritation," and in what cases is it found useful?

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No. 2.

1. Describe fully the different modes in which the official *extracts* are prepared, and give examples of each.

2. What kinds of *sulphur* are employed in medicine, and how are they prepared? What are their common impurities, and how may they be detected? What are the official preparations of sulphur?

3. In what forms and in what doses is *sulphate of iron* employed medicinally? Describe its action when administered internally, and state by what channel and in what form it is eliminated.

4. What are the chief pharmacological actions of *nitrite of amyl?* What are its therapeutic applications, and to what drugs is it most closely allied?

5. Give a list of the preparations of *belladonna* and its alkaloid. Describe the action of the latter upon (1) the eye, (2) the circulatory system, (3) the secretory glands.

6. What drugs are most commonly employed as *anthelmintics?* From what and by what menstruum is extractum filicis liquidum prepared? In what doses, and with what precautions should it be used?

No. 3.

1. Prepare a list of indigenous medicinal plants, giving the popular and scientific names of each.

2. Give an account of the pharmacological actions of *phosphorus*, describing the changes which it produces in the different organs and structures of the body. In what doses and in what forms is it usually prescribed?

3. Give the composition of the following pharmacopœial preparations:—Liquor arsenicalis, pilula hydrargyri subchloridi composita, mistura sennæ composita, syrupus chloral, linimentum calcis, mistura ferri composita.

4. What is an *emulsion*, and how does it differ from a solution? Give examples of drugs which may be administered in the form of an emulsion, with the method of preparation required in each case.

5. In what different forms do we meet with *cannabis indica?* Give an account of its physiological actions, describing in detail the symptoms produced by large doses.

6. By what pharmacological actions may (*a*) the diuretic and (*b*) the cardiac effects be produced of a substance which acts in a manner similar to digitalis?

No. 4.

1. Describe the different modes in which medicines may be introduced into the system, and illustrate your answer by examples. What drugs are most commonly given hypodermically, and with what objects?

2. What is an *infusion*, and how does it differ from a decoction? Illustrate your answer by examples.

3. What are the symptoms of chronic lead poisoning, and in what ways may lead be introduced into the system? What circumstances influence the action of drinking water on lead? Give the treatment of a case of chronic lead poisoning, with practical directions for the amelioration of the more distressing symptoms. Draw up a code of hygienic regulations especially applicable to men engaged in lead works.

4. Give an account of the physiological actions and therapeutical uses of *iodoform*.

5. What is the medicinal action, and what are the ordinary doses of *oil of turpentine*. Enumerate its pharmacopœial preparations.

6. Give an account of the composition and physical characters of *cod liver oil*. Explain its special facility of absorption and its value as a fattening agent.

No. 5.

1. What is an *essence*, according to the pharmacopœia? Give an official example, and state its composition, dose, and method of preparation.

2. Give an account of the physiological action and therapeutical uses of *bromide of potassium.*

3. Enumerate the officinal compounds and preparations containing *arsenic.* Give an account of its pharmacological actions and uses.

4. What do you mean by *antagonism* as applied to drugs? How would you demonstrate the antagonism which exists between atropine and pilocarpine? To what other drugs is atropine antagonistic, and to what drugs is it most closely allied?

5. What are the chief pharmacological actions of *nitro-glycerine?* What substances act in a similar manner?

6. Describe briefly any untoward effects which may result from the administration of medicinal doses of arsenic, quinine, iron, belladonna, iodide of potassium, chloral, nux vomica, and mercury.

No. 6.

1. Enumerate the chief *emetics.* Discuss their mode of action, and state in what cases and under what circumstances any of them would be specially indicated.

2. Describe the chief actions and uses of *perchloride of mercury.*

3. Give an account of the pharmacological actions of the sulphates of iron, sodium, magnesium, quinine, and atropine, and mention the dose and mode of administration of each.

4. What is the source of *pilocarpine?* Give an account of its pharmacological actions. How would you administer

it, and in what dose? To what drugs is it most closely allied, and by what drugs is its action antagonized?

5. What drugs are employed as *anæsthetics?* What are the comparative advantages of chloroform and ether as general anæsthetics? How would you use ether as a local anæsthetic?

6. Give an account of the mode of action of those drugs which, administered internally, influence the calibre of the systemic blood-vessels.

No. 7.

1. For what purposes and in what forms may substances be administered by the *rectum?* Illustrate your answer by reference to individual drugs and preparations.

2. Give an account of the physiological actions and therapeutical uses of *iodide of potassium.* What other iodides are used in the treatment of disease? What do you understand by the term "iodism"? What medicines administered internally often produce a rash on the skin?

3. Give an account of *ether,* including its mode of administration, physical and chemical characters, and general effects upon the system.

4. What are the chief alkaloids obtained from *cinchona bark?* Give a concise description of the pharmacological actions of sulphate of quinine, and state in what form and in what doses it is usually administered?

5. Prepare a list of drugs commonly *smoked* for their medicinal effects, and state for what purposes and in which diseases they are respectively employed.

6. What are the ordinary modes of administration of salicylic acid, nitrite of amyl, carbolic acid, chloral hydrate, red iodide of mercury, cocaine, and scammony?

No. 8.

1. What is an *alkaloid*, and how does it differ from a glucoside? Enumerate the liquid alkaloids which are official.

2. Give an account of the pharmacological actions of *bromide of potassium*.

3. Give the composition of the following preparations:— Mistura cretæ, pulvis jalapæ compositus, confectio sulphuris, lotio nigra, pulvis rhei compositus, mistura creasoti, linimentum camphoræ compositum.

4. Give an account of the pharmacological actions of *cantharides*, and prepare a list of counter irritants and vesicants, stating for what purposes and in what diseases they are commonly employed in medicine.

5. By what methods may effervescing compounds be prepared? What drugs are commonly employed for this purpose?

6. By what channels may drugs be eliminated from the body, and to what physiological effects may they give rise in the process?

No. 9.

1. What is a *suppository*? What substances are commonly employed as a basis? Mention the active ingredients of the official suppositories.

2. State explicitly what is meant by a *resin*, an *oleo-resin*, and a *gum resin*. Enumerate those in the Pharmacopœia, and state for what purposes and in what doses they are administered.

3. Give an account of the physical characters and pharmacological actions of *permanganate of potassium*.

4. Give an account of the action of *arsenious acid*. What are the doses of the drug, and of its official preparations?

5. Enumerate the official powders and pills containing *opium*, stating the proportion of active ingredients contained in each.

6. What drugs are most commonly employed as *anthelmintics?* From what and by what menstruum is extractum filicis liquidum prepared? In what doses and with what precautions should it be administered?

No. 10.

1. Enumerate the official *emetics*. Discuss the mode of action of these drugs, and indicate the mode of administration of each.

2. Enumerate the pharmacological preparations of *iodine*, stating the composition of each. Give an account of the pharmacological actions of iodine and of iodide of potassium.

3. What are the medicinal actions and what are the ordinary doses of *alum*, *tannic acid*, and *gallic acid?* Enumerate their official preparations, and give the strength of each of them.

4. Give an account of the action of *caffeine* on the circulation, on the urinary system, and on nutrition. Mention the doses and forms in which it is most commonly administered.

5. What are the chief therapeutical actions of the *nitrites?* What nitrites are commonly employed, and in what doses are they given?

6. Give an account of the group of *bitter tonics*, describing the mode of action, and methods of administration of the chief members of the class.

No. 11.

1. What do you understand by the term "tolerance," as applied to the habitual use of certain drugs? Give illustrations in support of your statements, entering fully into details in each instance.

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2. What forms of *sulphur* are used in medicine, and by what characters may they be distinguished? Name the preparations of sulphur, and offer any explanation that may occur to you of their composition. What is the dose of sulphide of calcium, and for what purposes is it employed therapeutically?

3. What preparation of *hydrocyanic acid* is official, and what other preparation is sometimes employed in dispensing? State the supposed strength of each, and refer to any variations in this respect with which you are acquainted. Give a detailed account of the pharmacological action of the drug, and mention the dose and form in which it is commonly prescribed.

4. In what different forms is *alcohol* employed, either as a medicine or as a beverage? State approximately the percentage of absolute alcohol contained in each, and give an account of the effects, both proximate and remote, which may result from excessive indulgence in its use in various forms.

5. Give an account of the pharmacological action of *physostigma* and its most important alkaloid. To what drugs are they most closely allied, and by what drugs is their action antagonized?

6. In what different forms is *cannabis indica* met with? Give an account of the symptoms which may be induced by its administration in the case of a person not habituated to its use.

No 12.

1. Digitalis—

(*a*) Origin.
(*b*) Active principles.
(*c*) Preparations with doses.
(*d*) Physiological action.
(*e*) Therapeutical uses.

2. Belladonna—

(*a*) Origin with parts used in medicine.
(*b*) Active principle.
(*c*) Physiological action.
(*d*) Allies and antagonists.

3. Acetate of Lead—

(*a*) Physical characters.
(*b*) Mode of introduction of lead into system.
(*c*) Description of plumbism.
(*d*) Treatment of this condition.

4. Meaning of—

(*a*) Sublimation.
(*b*) Distillation.
(*c*) Efflorescence.
(*d*) Fluorescence.
(*e*) Dialysis.

With examples.

5. List of—

(*a*) Emetics.
(*b*) Expectorants.
(*c*) Astringents.
(*d*) Laxatives.
(*e*) Purgatives.
(*f*) Counter irritants.
(*g*) Vesicants.
(*h*) Anæsthetics.
(*i*) Aphrodisiacs.

6. Opium—

(*a*) Origin.
(*b*) Liquid preparations.
(*c*) Alkaloids.
(*d*) Acids.
(*e*) Physiological action of morphine.
(*f*) Forms of administration of morphine, with doses.

No. 13.

1. Enumerate and classify the chief *purgatives*. In what different ways do they produce their effects? Discuss fully the mode of action of saline purgatives.

2. What is *argyria*? Under what circumstances is it produced, and how would you guard against its occurrence?

3. Discuss the advantages and disadvantages of *hypodermic medication*. Prepare a list of drugs commonly employed hypodermically. State with what objects each is administered, and in what doses it should be given.

4. Give an account of the pharmacological effects of *pilocarpine*, pointing out the actions of the drug which are antagonized by atropine and its congeners.

5. What is collodion, and how is it prepared? How does it differ from flexile collodion, and for what purposes are these drugs employed in medicine?

6. Enumerate the drugs which alter the volume and composition of the urine, and discuss their modes of action.

No. 14.

1. What *antipyretics* are commonly employed in medicine? State what is known respecting their modes of action, and indicate any untoward effects which may follow the administration of any of them if administered in excessive doses.

2. Give an account of the therapeutical uses of *sulphide of calcium.*

3. What is an *expectorant*, and by what different actions are the effects of expectorants produced? Give precise directions for the administration of apomorphine as an expectorant.

4. Write an account of the chief medicinal uses of *glycerine*, and state for what purposes, and in what forms, it is commonly given internally.

5. What drugs and other measures influence the secretion of the sweat? Indicate clearly their methods of application and modes of action.

6. What do you understand by the term *accumulation*, as applied to the action of certain drugs? Illustrate your remarks by reference to the digitalis group.

VIVÂ VOCE EXAMINATIONS.

The following are examples of ten minutes' *vivâ voce* examinations. With a limited range of subjects it will be seen that there is a constant tendency to repetition.

No. 1.

What forms of sulphur are employed in medicines? How do you distinguish the sublimed from the precipitated sulphur? What are the common impurities in precipitated sulphur? What are the preparations of sulphur? How is the ointment prepared? Why do you use benzoated lard? How is benzoated lard prepared? What is the composition of the confection? In what dose would you give it? What is its action? What is a laxative? What other drugs possess a laxative action? Mention some active

purgatives? How would you use the sulphur ointment as an antiparisiticide, say, in a case of scabies? What inconveniences might result from the use of a too active preparation? How is sulphur eliminated? What is your evidence that it is eliminated by the breath? What is the action of sulphide of calcium? In what cases would you prescribe it, and how would you give it? Has it any toxic action? To what is that toxic action due? What sulphates are used in medicine? What is the dose of the dried sulphate of iron? How would you give it? How would you prevent its constipating effects? What is the dose of sulphate of sodium? What do you know about the action of saline purgatives? What do you consider the most active purgative? How would you give elaterium? What is jalapin? What drugs are used as astringents? What drugs are employed to check hæmorrhage? What precautions would you use in giving a hypodermic injection of ergotin? What are the advantages of hypodermic medication? What other drugs are used hypodermically, and for what purposes?

No. 2.

What are the physical characters of iodine? How is it affected by heat? Is it soluble in water? What is the best method of getting it into solution? What are its preparations? What is the strength of the liniment? What is a counter-irritant, and what does it do? How does it act? What drugs are employed as counter-irritants? What iodides are used in medicine? What do you understand by iodism? What are the symptoms? What do you understand by the term coryza? What is the ordinary dose of iodide of potassium? In what cases do you employ larger doses? What are the supposed advantages of iodide of sodium over iodide of potassium? How do sodium salts

differ generally from the corresponding potassium salts? What drugs act as heart tonics? What are usually described as the active principles of digitalis? Are they alkaloids? How do alkaloids differ from glucosides? What are ptomanies? To what drug is digitalis most closely allied? What is the origin of strophanthus? What drugs act on involuntary muscular tissue? How does strychnine act as a laxative? How would you give it? How does strychnine differ in action from picrotoxin? Is picrotoxin an alkaloid? What is its origin? What are its therapeutical uses? What other drugs are used to check morbid sweating? What is the action of oxide of zinc? What drugs influence the urinary secretion? What drugs assist in the elimination of urea? What drugs retard its elimination? What relationship exists between chronic lead poisoning and gout?

No. 3.

What is the origin of chloride of ammonium? What is the popular name for this salt? What are its physical characters? Has it any odour? How would you distinguish it from the carbonate? Has it any taste? How would you administer it? How would you disguise the taste in a mixture? What are its therapeutical uses? In what doses would you give it as an expectorant? What would be the dose in a case of neuralgia? How long would you continue its administration? What other expectorants are commonly employed? How do they act? How would you give apomorphine as an expectorant? What dose would you give? What is the origin of apomorphine? What preparation of this drug would you employ? Why is this preparation directed to be freshly prepared? What would happen if it were not freshly prepared? Would there be any objection to administering it with morphine? What is

the action of apocodeine? What is the origin of codeine? What other alkaloids are contained in opium? What is the chief acid of opium? What is supposed to be its action or use? What drugs antagonize opium? How would you treat a case of opium poisoning? What drugs are most closely allied in action to caffeine? What drugs increase the urinary secretion? What drugs render the urine acid? What is the influence of the alkalies on the reaction of the urine?

No. 4.

What is the source of belladonna? What active principle does it contain? Into what can atropine be resolved? What is its physiological action? To what alkaloids is it allied? How would you demonstrate the antagonism of atropine to pilocarpine? What is the action of atropine on the pupil? What is the physiological explanation of the action? What are the arguments in favour of its being a local rather than a central action? In what dose is atropine usually given to check sweating? How does belladonna act in cases of incontinence of urine? What other drugs stimulate involuntary muscular action? How do you explain the action of small doses of nux vomica in cases of constipation? With what alkaloid is strychnine most commonly associated? What is curare? What is its action? What drugs act as tetanizers? What alkaloids besides thebaine are contained in opium? What alkaloids may be derived from morphine? In what respects is morphine allied to atropine or antagonistic to it? Give other examples of physiological antagonism. Give examples of chemical antagonism. What do you know of explosive combinations? How would you prescribe permanganate of potassium? What is kaolin? What drugs are commonly given in amenorrhœa? What is the action of ergot? What is

ergotin? What precautions would you take in giving it hypodermically? What are abortifacients? What drugs are commonly included in this category? How would you give colocynth as a purgative? Why is colocynth often given with hyoscyamus? What are the types of ingredients in a prescription? Give typical examples. How would you prescribe the liquid extract of male fern? What are the chief anthelmintics? What would be your directions for the treatment of a case of thread-worms? What drugs do children take with comparative impunity? To what drugs are children especially susceptible?

No. 5.

What is an alkaloid? How does it differ from a glucoside? What are ptomaines? Under what circumstances are they formed? What alkaloids have been produced synthetically? How does chemical composition modify physiological action? Give examples. What alkaloids are contained in opium? What are the derivatives of morphine? What is the action of codeine? In what dose would you give it? What are its therapeutical uses? What is the action of apomorphine? How would you use it as an emetic? What is its dose as an expectorant? What is the action of thebaine? What other alkaloids act as tetanizers? With what alkaloid is strychnine commonly associated? What drugs depress the action of the cord? What is the origin of physostigma? What alkaloids does it contain? To what drugs is calabarine allied? What drugs paralyze the motor nerves? What is the origin of curare? For what purpose is it used in physiological experiments? Is it an anæsthetic? How would you classify anæsthetics? How would you use ether as a local anæsthetic? What disadvantages may attend its employment? What is the chief danger of chloroform as an anæsthetic? What is

your treatment of chloroform poisoning? What is the composition of spirit of chloroform? In what dose would you give it, and in what cases? What drugs are commonly employed in flatulence? What is an essential oil? How would you distinguish a volatile oil from a fixed oil? What is the dose of oil of cajeput? What is its value as a local application? Mention some stimulating liniments. How would you use the liniment of iodine?

No. 6.

What preparation of hydrocyanic acid is official? What is the strength? What is Schele's acid? What is its strength? What is the physiological action of prussic acid? On what tissues does it act? In what ways may it be introduced into the system? What are the toxic symptoms? What are the therapeutical uses of the official solution? How would you administer it? What is the dose? What is the dose of nitroglycerine? of aconitine? of atropine? of strychnine? of elaterin? of iodide of potassium? and of tincture of perchloride of iron? What do you understand by antagonism? Give examples of physiological antagonism. To what drugs is atropine antagonistic? How would you demonstrate the antagonism of atropine for pilocarpine? What drugs, besides atropine, dry the mouth? What drugs dilate the pupil? What drugs contract it? What drugs dilate the blood-vessels? How would you demonstrate the physiological action of nitrite of amyl? To what drugs is nitrite of amyl most closely allied? How would you administer nitroglycerine? Suggest a convenient mixture for a case of angina pectoris. What do you understand by tolerance? Give examples of idiosyncrasy with respect to drugs. What kinds of rash are produced by the iodides? What other drugs produce a rash on the skin? What is argyria? What precautions would you take to

prevent its occurrence? What drugs are supposed to have an accumulative action? Explain this with reference to digitalis. What are the active principles of digitalis? To what drug is digitalis most closely allied?

No. 7.

What are antispasmodics? Give examples. What are resins? How do they differ from gum-resins? What substances are commonly employed to make emulsions? How would you prescribe assafœtida? In what cases is it found useful? To what drugs is it most closely allied? How is guiacum resin obtained? What is the action of guiacum? How would you administer it? What is guiacol? What are its solubilities? How would you give it in a case of phthisis? What are the physical characters of iodoform? For what purpose is it employed? How would you disguise its odour? How would you administer it internally? How would you use it as an inhalation? What is an antiseptic? What drugs belong to this group? What are the chief anæsthetics? What are the relative advantages of chloroform and ether as anæsthetics? How do these drugs act on the frog's heart? What form of apparatus would you employ for demonstrating these facts? How can the action of chloroform on the frog's heart be antagonized? What drugs of animal origin are employed in medicine? What do you understand by the term "serum therapeutics"? What is the smallest dose of any drug which will produce physiological effects? What is the medicinal dose of nitro-glycerine? What is the toxic dose of anhydrous hydrocyanic acid? Write a prescription for an effervescing iron mixture, for a stimulating liniment, for a purgative pill, and for an astringent vaginal injection.

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No. 8.

What is the origin of salicylic acid? From what sources may it be obtained? What are the differences between the natural and the artificial acids? How is the artificial acid prepared? How may it be purified? What are the physical characters of the purified acid? What physiological symptoms are said to follow the administration of salicylic acid? To what are they probably due? How is salicylate of sodium prepared? How would you employ it in a case of acute rheumatism? How is it eliminated? What changes does it produce in the urine? What is the most toxic alkaloid of opium? To what other alkaloids is it most closely allied in action? What is the physiological action of anarcotine? In what dose would you give it? To what other alkaloids is it most closely allied? What is an anti-periodic? How would you employ quinine in a case of ague? How would you give it if rejected by the stomach? For what different purposes are enemata commonly prescribed? Give a formula for an opium enema. What is the strength of the official morphine suppository? In what cases would you use it? Is there any risk in its employment? Give some account of the metric system. How would you convert grains into grammes? Write a simple prescription, such as a gentian and soda mixture according to the metric system, indicating the doses.

No. 9.

What is dialysis? What is the most convenient substance to use for a dialyzing medium? What are crystalloids? What are colloids? How is dialyzed iron prepared? What are the chief inorganic salts of iron? Write a prescription for a perchloride of iron mixture. How would

you give the sulphate in pill? What are the scale preparations of iron? With what drug are they most likely to be confounded? What is the action of iron on the blood? How do iron salts affect the fæces? How is iron eliminated? What are the chief therapeutical uses of iron? What are the therapeutical uses of nitrate of silver? What effects may result from its long continued administration? What is the action of oxide of zinc, and for what purposes is it given? What is the action of the sulphate? In what doses may it be given? What do you understand by "tolerance," as applied to drugs? Give examples. With what forms of chronic alcoholism are you acquainted? What are the symptoms? How is alcohol eliminated? For what pharmaceutical purposes is alcohol employed? What are the chief anæsthetics? What are the comparative advantages of ether and chloroform? What drugs are commonly employed to prevent fermentation? For what purposes is salicylic acid employed as an external application? What is its dose for internal administration? How is it eliminated? Has it any cumulative action? What drugs taken internally alter the condition of the urine? What is sublimation? How does it differ from distillation and from evaporation? How would you prepare fumes of chloride of ammonium, and for what purpose are they employed therapeutically?

No. 10.

What are the principal digestive ferments? How would you peptonize milk? How is pepsine prepared? What is its action? How would you test its activity? In what dose would you give it, and how? What other drugs of animal origin are used in medicine? How is cod liver oil prepared? What are its physical characters? What are its advantages over vegetable oils? How is it absorbed? In

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what dose would you give it? What are the best modes of administration? What is the origin of cantharides? What are its uses externally? and internally? What is its action on the kidneys? What is an "aphrodisiac"? What other drugs are supposed to be aphrodisiacs? What is the dose of tincture of perchloride of iron? In what cases is it given in exceptionally large doses? How would you give iron in an effervescing mixture? What are the chief diaphoretics? What is the composition of Dover's powder? What are the chief hypnotics? How would you give paraldehyde? To what drug is it most closely allied? What would you do in a case of chloral poisoning? And what in a case of poisoning by strychnine? How do you distinguish strychnine tetanus from traumatic tetanus? How would you prescribe sulphonal? How would you give santonin? What drugs are commonly used as inhalants? What drugs are commonly smoked? How would you make nitre papers? What preparations are there of lobelia? What are the chief cardiac tonics? And what are the chief cardiac depressants? In what form is heat applied as a therapeutic agent?

THE SYLLABUS OF THE CONJOINT BOARD OF THE ROYAL COLLEGE OF PHYSICIANS OF LONDON, AND THE ROYAL COLLEGE OF SURGEONS OF ENGLAND.

Pharmacology is defined in this Syllabus as follows:—

"The action of Medicinal Agents on the Body in Health and Disease."

This definition seems to be a very imperfect one, and is not in accordance with the teaching of the best authorities. The action of medicinal agents in disease does not fall

within the scope of Pharmacology. Apparently by "Pharmacology" is meant, "Pharmacology and Therapeutics."

The range of the examination extends to the following subjects:—

1. The application of heat and cold, by both dry and moist methods.

2. Bleeding, leeching, and cupping.

3. Counter-irritation.

4. The drugs and preparations enumerated in the following SCHEDULE:—

Liquor chlori; Calx chlorinata; Liquor sodæ chlorinatæ.

Bromum; Ammonii bromidum; Potassii bromidum; Sodii bromidum.

Iodum; Potassii iodidum; Sodii iodidum; Plumbi iodidum.

Sulphur sublimatum; Sulphur prœcipitatum; Calx sulphurata; Potassa sulphurata.

Phosphorus; Calcii phosphas; Sodii phosphas; Ferri phosphas; Calcii hypophosphis; Sodii hypophosphis.

Acidum hydrochloricum; acidum nitricum; acidum sulphuricum.

Acidum aceticum; Acidum citricum; Acidum tartaricum.

Acidum boricum; Acidum sulphurosum.

Acidum hydrocyanicum dilutum.

Liquor ammoniæ; Liquor potassæ; Liquor sodæ; Potassa caustica; Soda caustica.

Ammonii carbonas; Ammonii chloridum; Liquor ammonii acetatis.

Potassii bicarbonas; potassii sulphas; Potassii chloras; potassi tartras acida; Potassii permanganas.

Sodii bicarbonas; Sodii sulphas; Sodii nitris; Borax.

Calx; Calcii hydras; Creta præparata; Calcii carbonas præcipitata.

Magnesia; Magnesii carbonas; Magnesii sulphas.

Alumen; Alumen exsiccatum.

Zinci oxidum; Zinci chloridum; Zinci sulphas.

Cupri sulphas.

Argenti nitras.

Hydrargyrum; Hydrargyri oxidum flavum; Hydrargyri oxidum rubrum; Hydrargyri subchloridum; Hydrargyri perchloridum; Hydrargyri iodidum rubrum; Hydrargyrum ammoniatum; Liquor hydrargyri nitratis acidus.

Plumbi oxidum; Plumbi acetas; Liquor plumbi subacetatis.

Antimonium tartaratum.

Acidum arseniosum; Ferri arsenias; Sodii arsenias; Arsenii iodidum; Liquor arsenii et hydrargyri iodidi.

Bismuthi subnitras; Bismuthi carbonas; Bismuthi citras.

Ferrum; Ferri sulphas; Ferri sulphas granulata; Ferri sulphas exsiccata; Syrupus ferri subchloridi; Ferri carbonas saccharata; Syrupus (et Pilula) ferri iodidi; Liquor ferri acetatis; Liquor ferri perchloridi; Liquor ferri pernitratis; Liquor ferri persulphatis; Ferri peroxidum hydratum; Liquor ferri dialysatus; Ferri et ammonii citras; Ferri et quininæ citras; Ferrum tartaratum; Ferrum redactum.

Alcohol ethylicum; Spiritus rectificatus; spiritus Tenuior; Æther; Chloroformum; Iodoformum.

Chloral hydras; Butyl chloral hydras; Paraldehydum; Sulphonal.

Amyl nitris; Tabellæ nitroglycerini; Liquor trinitrini; Spiritus ætheris nitrosi.

Acetanilidum; Phenacetin; Phenazonum.

Collodium.

Acidum carbolicum; Acidum salicylicum; Sodii Salicylas.

Aconiti radix et folia; aconitina.

Opium; Morphinæ hydrochloras; Morphinæ acetas;

Morphinæ sulphas; Liquor morphinæ bimeconatis; Apomorphinæ hydrochloras; Codeina.

Coca; Cocainæ hydrochloras.

Jaborandi; Pilocarpine nitras.

Quassiæ lignum; Calumbæ radix; Gentianæ radix.

Physostigmatis semen; physostigmina.

Caffeina; Caffeinæ citras.

Conii fructus et folia.

Asafœtida; Ammoniacum; Myrrha; Guaiaci resina.

Cinchonæ cortex; Cinchonæ rubræ cortex; Quininæ sulphas; Quininæ hydrochloras.

Salicinum.

Ipecacuanha; Senega radix.

Glycerinum.

Nux vomica; strychnina.

Belladonnæ radix et folia; Atropina; Atropinæ sulphas; Hyoscyami folia; Stramonii semina et folia; Homatropinæ hydrobromas.

Cannabis indica.

Digitalis folia; Strophanthus.

Oleum ricini; Oleum crotonis; Aloe barbadensis; Aloe socotrina; Aloin; Rhamni purshiani cortex; Colocynthidis pulpa; Elaterium; Elaterinum; Jalapa; Podophylli rhizoma; Rhei radix; Senna Alexandrina et Indica; Camphora; Oleum terebinthinæ.

Acidum tannicum; Acidum gallicum; Kino; Catechu; Hamamelidis cortex et folia.

Acidum benzoicum.

Copaiba. Cubeba.

Colchici cormus et semina.

Scilla.

Filix mas. Santoninum.

Ergota.

Oleum morrhuæ.

Cantharis.

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5. The usual toxic effects of—

Phosphorus.
Drugs containing arsenic, mercury, and lead.
Iodides, bromides and salicylates.
Chloroform and chloral hydrate.
Morphine, atropine, strychnine and quinine.
Acetanilide and phenazone.
Digitalis, ergot, camphor, oil of turpentine, and cantharides.

It will be noted that in the schedule the drugs are not arranged in the order of their pharmacological relationship, a circumstance which does not facilitate the work of the student. For example, there is no reason why hydrocyanic acid should have been interpolated between the acids and the alkalies, seeing that it has no pharmacological association with either group.

The scope of the examination is held to include any of the following actions :—

Caustic action; the production of eschars, blisters, and pustules; the formation of protective coatings.

Actions on the peristaltic movements of the alimentary canal and on the secretions of the glands connected with it; on the processes of digestion; on the appetite. The production and arrest of nausea and vomiting.

Actions on the composition of the blood; on its corpuscles and leucocytes; on cell-movements; on nutrition and metabolism.

Actions on the muscular walls of the heart and its intrinsic ganglia; on its accelerator and inhibitory apparatus; on the muscular coats of arteries and arterioles; on the blood-pressure and blood-flow. Rubefacient and irritant action; astringent action; arrest of hæmorrhage.

Actions on the processes of inflammation, acute and chronic.

Actions on absorption; on the absorption of serous and inflammatory effusions.

Actions on the secretory apparatus of the kidneys, and the composition of the urine.

Actions on the cutaneous and mammary glands.

Actions on the movements of respiration and the secretions of the respiratory tract.

Actions on the higher cerebral functions. The production and prevention of sleep.

Actions on the sensory functions of the nervous system. The production of anæsthesia, local and general. The relief of pain. Actions on the special senses.

Actions on the reflex and motor functions of the nervous system, and on muscular tissue. The production and arrest of spasm, convulsions, and cough.

Actions on the intrinsic muscles of the eye.

Actions on the gravid uterus; on the catamenial flow.

Actions on the temperature of the body; on pyrexia and hyperpyrexia.

Actions on specific *materies morbi;* on microbes and ferments; on the processes of putrefaction and infection.

Antidotal action with regard to other drugs.

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